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ABSTRACT

This volume presents 27 conference papers: (1) "1985 Killing Waters Revisited: Physical Plant Emergency Preparedness" by Al Ingle; (2) "We Were Prepared: UC (University of California) Santa Cruz Experience in a 7.1 Earthquake" by F. Louis Fackler; (3) "Indoor Air Quality of Buildings and Schools" by Marilyn S. Black; (4) "Resolving Indoor Air Quality (IAQ) Problems in a New University Library" by Aidan E. Kiernan; (5) "Mechanical Service Containments Issues in Design of Biohazard Laboratories" by Dave Goswami and Michael R. Lorenz; (6) "Biting the Training Bullet: Why You Should and How" by Gary R. Kent; (7) "Building a Foundation for Excellence" by Aimee L. Hill; (8) "In-House Development of Custodial Supervisors: A Success Story" by Gregory D. Fichter; (9) "Thirty Ways to Improve Custodial Productivity" by Jon H. Fraker; (10) "Time Management" by Nina Crawley; (11) "Sexual Harassment: Problems and Solutions" by John D. Rulfs and Sherry L. Rulfs; (12) "Developing an Active Public Relations Strategy" by Frank J. Schmidt; (13) "A Community College Goes Shopping for Space" by Nicholas Cimino; (14) "Construction Management: The Owner's Perspective" by Douglas K. Ault and John Kreidich; (15) "Utilities Master Planing in the Campus Setting" by Edward C. Knipe; (16) "Site Planning and Management: An International Review" by Ted Dews and Sam Ragusa; (17) "The Design-Build Team: A Success Story" by Kenneth G. Smith and J. Richard Swistock; (18) "Special Considerations in Designing a Research Building" by Daniel Carl Johnson; (19) "Reviving a Troubled Construction Project" by S. Leonard DiDonato and William R. Loew; (20) "A Project Management Approach to Managing Work Control" by Roy C. Allen; (21) "New Maintenance Practices and Technology" by Adly Abdel Fattah; (22) "Thermal Energy Storage for the Large and Small Campus" by Glen L. Carver; (23) "Electrical Energy Management Through Lighting Retrofits" by Paul D. Black; (24) "Capital Renewal/Deferred Maintenance" by Frank J. Kuszpa, Jr.; (25) "The Decaying Australasian Campus: The Antipodean Time Bomb" by William J. Humble and Maurice R. Pawsey; (26) "The General Building Preservation Plan" by Pierre Fleurant; and (27) "Physical Plant Performance Evaluation Pulse Points" by Robert L. Allen. Some papers contain references. An appendix lists annual meeting speakers. (JB)

77th Annual Meeting
Ottawa, Canada

Proceedings of

The Seventy-Seventh Annual Meeting of The Association of Physical Plant Administrators of Universities and Colleges

July 1-4, 1990 • Ottawa, Canada

Vice President for Educational Programs:
William A. Daigneau, University of Rochester

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Table of Contents

ENVIRONMENTAL SAFETY AND EMERGENCY PREPAREDNESS

1985 Killing Waters Revisited: Physical Plant Emergency Preparedness 3
Al Ingle

We Were Prepared: UC Santa Cruz Experience in a 7.1 Earthquake 14
F. Louis Fackler

Indoor Air Quality of Buildings and Schools 21
Marilyn S. Black

Resolving IAQ Problems in a New University Library 31
Aidan E. Kiernan

Mechanical Service Containment Issues in Design of Biohazard Laboratories 40
Dave Goswami & Michael R. Lorenz

EMPLOYEE PRODUCTIVITY AND DEPARTMENTAL COMMUNICATION

Biting the Training Bullet: Why You Should and How 57
Gary R. Kent

Building a Foundation for Excellence 65
Aimee L. Hill

In-House Development of Custodial Supervisors: A Success Story 74
Gregory D. Fichter

Thirty Ways To Improve Custodial Productivity 88
Jon H. Fraker

Time Management 93
Nina Crawley

Sexual Harassment: Problems and Solutions 101
John D. Rulfs & Sherry L. Rulfs

Developing an Active Public Relations Strategy 108
Frank J. Schmidt

FACILITIES PLANNING AND CONSTRUCTION

A Community College Goes Shopping for Space 121
Nicholas Cimino

Construction Management: The Owner's Perspective 128
Douglas K. Ault & John Kreidich

Utilities Master Planning in the Campus Setting 140
Edward C. Knipe

Site Planning and Management: An International Review 151
Ted Dews and Sam Ragusa

The Design-Build Team: A Success Story 168
Kenneth G. Smith & J. Richard Swistock

Special Considerations in Designing a Research Building 174
Daniel Carl Johnson

Reviving a Troubled Construction Project 187
S. Leonard DiDonato & William R. Loew

PHYSICAL PLANT OPERATIONS AND MAINTENANCE

A Project Management Approach to Managing Work Control 207
Roy C. Allen

New Maintenance Practices and Technology 217
Adly Abdel Fattah

Thermal Energy Storage for the Large and Small Campus 228
Glen L. Carver

Electrical Energy Management Through Lighting Retrofits 236
Paul D. Black

Capital Renewal/Deferred Maintenance 251
Frank J. Kuszpa Jr.

The Decaying Australasian Campus: The Antipodean Time Bomb 263
William J. Humble & Maurice R. Pawsey

The General Building Preservation Plan 288
Pierre Fleurant

Physical Plant Performance Evaluation Pulse Points 301
Robert L. Allen

APPENDIX

Annual Meeting Speakers 313

77th Annual Meeting
Ottawa, Canada

Environmental Safety and Emergency Preparedness

1985 Killing Waters Revisited: Physical Plant Emergency Preparedness

Al Ingle
Assistant Director for Business and Administration
West Virginia University

From the windy beaches of South Carolina .... across the North American Continent to the rugged shores of northern California .... and back again to the wilderness of the Appalachian Mountains .... the devastation of disaster shows no favoritism, it leaves no land on this earth untouched.

On Monday and Tuesday, November 4th, and 5th, 1985 the State of West Virginia was devastated by one of the most severe floods in the history of the United States. More than 13 West Virginia rivers including: the Shenadoah, Monongahela, Cheat, Potomac, Tygart, and Gully, to name only a few, overflowed their banks destroying most life and property in their path.

Day One .... it began to rain .... and rain .... and rain .... and when it was thought it would stop .... it rained somemore. People in the rural counties of West Virginia, who were experienced in the devastation that could be imposed by this "Old Man River", sent out the word that .... "this will be a big one".

Day Two .... The State Government responded to the continuing rains as 13 rivers that touched on, or were within, the boundaries of West Virginia swelled from 10 to 15 feet above flood stage. State agencies begin to respond in a planned pattern established through experience of the past.

Day Three .... As rains begin to slow, runoff from the highlands took their toll in the valleys below where most bridges and towns are situated. The Governor requested national emergency funding and ordered all state agencies to respond with relief.

Day Four.... As the worst of the raging water was felt downstream, President Reagan declared a national state of emergency for 29 of the 55 West Virginia Counties.

Day Five .... "Working together works," an intense cleanup began. **City folks and country folks joined together.** State, County and municipal forces joined in an all out effort to reestablish, what state residents, even after all this, still believe to be "Almost Heaven".

SOME ESTIMATED STATISTICS ABOUT THE DISASTER OF 1985:

Loss of Life ----------------------------48
Treated for Injury ----------------------3,000
Homes Lost ------------------------------4,000
Homes Damaged --------------------------12,000
Residential Loss of Utilities ----------20,000
Displaced Persons -----------------------32,000
Daily Precipitation ---------------3 to 6 inches
Total Precipitation ---------------8 to 15 inches
Highest Recorded Crest Above Flood Stage ---18 feet
Cost of Flood Damage in West Virginia ---
One Half Billion Dollars

West Virginia University was spared significant flood damage due to its high location overlooking the Monongahela River. However, from both the Downtown and Evansdale Campuses, one could look down on the Monongahela River, and as it grew mighty and monstrous and watch as the small community of Granville on the opposite bank eventually disappeared below the surface of the river's mighty waters.

With devastation and suffering all around ....the West Virginia University Community joined immediately in a flood relief effort bringing to the task, not only the dedication of "people helping people", but a wide range of expertise that exists only in the Facilities and Services area of a University. As part of its land grant mission, West Virginia University acted quickly to respond to the need. Then acting President Dr. Diane Reinhard, said it best shortly after the flood began, **"It is critical that we pull together to show our support for the victims of this disaster".**

As a result of state authorization, University employees were told they could volunteer for relief work without loss of pay or vacation time. As the relief effort got underway, the West Virginia University Physical Plant was one of the University units most actively involved with flood relief. Within hours of authorization teams of Physical Plant carpenters, plumbers, electricians, millwrights as well as administrative personnel were riding off to damaged towns to help put critical services back in order. Trucks with workers and equipment left the campus before dawn so that work could begin at "first light". Trucks carried all necessities for the day, including food, drinking water, tools, and parts needed to reestablish utility service, and shore up damaged homes and buildings.

The overall relief effort extended to involvement by numerous University Colleges, with faculty, staff, and students all volunteering their time and expertise to overcome the pillage of this natural disaster. In the final analysis, more than 50,000 hours were donated by West Virginia University personnel in the relief effort. A large percentage of this effort was by Physical Plant personnel and their families.

During 1986, as the 29 disaster counties, the state of West Virginia and all of its people began to recover, West Virginia University's Facilities and Services Division began a systematic review of the disaster response to the floods of 1985. The Emergency Preparedness Committee was established as a subcommittee to the University wide Safety Committee. As a result of Physical Plant actions during the floods this Committee was chaired by the Physical Plant. The Committee was charged with the responsibility of identifying the strengths and weaknesses of West Virginia University's response to the emergency with particular focus on a more formal emergency preparedness policy, potential emergency condition identification system, development of emergency organization, and unit preparedness training and methodology. West Virginia University gained a great deal from the work of the Committee. What was learned is the primary message of this report.

The process of preparing for the inevitable, but unexpected campus emergency, is the responsibility of everyone in the institutional community. Emergency Preparedness programs must acknowledge the part Physical Plant personnel play in the Program, and stress the need for a "systems approach", with Physical Plant as the recovery manager. Training programs should be conducted periodically by emergency service units to insure that personnel are familiar with emergency assignments and are competent to execute them.

In developing Emergency Preparedness programs, participants must develop methods to cope with unknown future conditions. The Emergency Preparedness process must become a routine part of the "action units" business. When participants must respond without the benefit of an "institutionalized" plan, the response will be without reliable action. The Physical Plant must be ready to address emergencies when they happen.

An Emergency Preparedness Plan should provide a system for meeting emergencies of a magnitude that may cause a significant disruption of University or College services. The plan should be designed to protect human lives first and property second while facilitating a return to normal operations.

An Emergency Preparedness Plan must be flexible. It must be possible to activate part, or all, of the plan depending upon the nature, level, and type of emergency situation involved. While variations can work, the planning documentation should be divided into at least three major areas:

A. Nature - General emergency conditions
B. Level - Magnitude of emergency
C. Type - Specific kind of emergency

Additionally, support systems including personnel, services, and equipment available must be considered and detailed:

D. Services - Identification
E. Personnel - Responsibility/authority
F. Equipment - Resources available/needed

Figure A shows general emergency conditions that should be considered in developing an Emergency Preparedness Program. These eight conditions show categories that lend themselves to the different types of preparation recommended by emergency specialists. Each has been identified to insure that consideration is given to the unique characteristics of the particular emergency condition. For example, code identification #2 outlines "civil disorder" as an emergency condition. Actions that must be taken under this emergency condition are of a different nature than that taken under code identification #4 which is a "utility" emergency condition. Actions under each of the eight conditions are unique in nature and require a variety of distinct and different actions for best control.

FIGURE "A" - GENERAL EMERGENCY CONDITIONS

CODE ID	NATURE OF EMERGENCY	DESCRIPTION
1.	NATURAL ELEMENT EMERGENCY	ANY UNUSUAL NATURAL OCCURRENCE THAT HAS THE POTENTIAL TO CAUSE DISRUPTION OF NORMAL ACTIVITIES
2.	CIVIL DISORDER EMERGENCY	ANY ACTIONS BY A PERSON OR PERSONS THAT HAVE THE POTENTIAL TO CAUSE BODILY HARM
3.	STRUCTURAL EMERGENCY	ANY EMERGENCY RELATED TO BUILDING OR FACILITY PROBLEMS
4.	UTILITY EMERGENCY	ANY PROBLEMS ASSOCIATED WITH UTILITIES SUCH AS NATURAL GAS, ELECTRICITY, WATER, OR COMMUNICATION FAILURE OR ERATIC OPERATION
5.	TRANSPORATION EMERGENCY	ANY UNPLANNED ACTIVITIES RELATED TO EQUIPMENT AND VEHICLES THAT HAVE THE POTENTIAL OF CAUSING HUMAN INJURY
6.	CHEMICAL EMERGENCY	ANY ABNORMAL CONDITIONS RELATED TO CHEMICAL UTILIZATION
7.	UNDERGROUND EMERGENCY	ANY SUBSIDENCE OR DISTURBANCE IN UNDERGROUND LOCATIONS
8.	OFF CAMPUS SUPPORT	ANY CONDITIONS WHATSOEVER THAT OCCUR OUTSIDE THE UNIVERISTY COMMUNITY WHERE IT IS DEEMED NECESSARY TO UTILIZE UNIVERSITY SUPPORT

Figure B shows identification for the magnitude of the emergency condition. The identification enumerates various levels of emergency preparedness from "watch" through "demobilization". Utilizing these code identifiers along with the "nature of emergency" code identification, emergency operations personnel can understand what actions must be taken as part of the emergency operations team.

FIGURE "B" - MAGNITUDE OF EMERGENCY CONDITION

CODE IF	LEVEL OF EMERGENCY	DESCRIPTION
A.	WATCH	SIGNS OF IMPENDING PROBLEM
B.	WARNING	PROBLEM IS IMMINENT--GET READY
C.	MOBILIZE	BEGIN TO OPERATE ACCORDING TO APPROPRIATE PLAN
D.	ACTION	EXECUTE UNDER FULL SCALE EMERGENCY OPERATION
E.	OPERATION	CONTINUE EXECUTION
F.	HOLD	STOP EXECUTION PENDING FURTHER INSTRUCTION
G.	DEMOBILIZE	REVERT TO NORMAL OPERATION

Figure C lists types of emergencies that can be identified within each of the emergency conditions outlined in Figure A. While each campus will have unique characteristics that dictate a different list of emergency types, those shown in Figure C can be used in considering development of emergency plans.

FIGURE "C" - TYPES OF EMERGENCY CONDITIONS

CODE ID	TYPE OF EMERGENCY
	NATURAL ELEMENT EMERGENCY
1.	DISEASE
2.	DROUGHT
3.	EARTHQUAKE
4.	EVACATION
5.	FLOODING
6.	FOREST FIRE
7.	HAIL STORM
8.	HIGH WINDS
9.	INSECTS
10.	LAND FIRE
11.	LANDSLIDE
12.	SNOW
13.	TORNADO
14.	UNCONTROLLED ANIMAL
	CIVIL DISORDER EMERGENCY
15.	ARSON
16.	DEMONSTRATION
17.	DOMESTIC DISTURBANCE
18.	EVACUATION
19.	EXPLOSION
20.	EXPLOSIVES
21.	HOSTAGE
22.	LOOTING
23.	RIOT
24.	SNIPER
25.	SUICIDE
	STRUCTURAL EMERGENCY
26.	BOMB THREAT
27.	BUILDING COLLAPSE, FLOOR COLLAPSE, OR ANY TYPE OF STRUCTURE COLLAPSE
28.	BUILDING FIRE
29.	EVACUATION
30.	EXPLOSION
31.	JAMMED ELEVATOR
32.	PRT COLLAPSE
33.	STRUCTURE DAMAGE
	UTILITY EMERGENCY
34.	EVACUATION
35.	LOSS OF COMMUNICATION
36.	LOSS OF GAS SUPPLY
37.	LOSS OF ELECTRICAL SUPPLY
38.	LOSS OF WATER SUPPLY
39.	MAJOR COMPUTER FAILURE
40.	MASS BLACKOUT
41.	NATURAL GAS LEAK
42.	POWER LINES DOWN
43.	WATER CONTAMINATION
44.	AIRPLANE CRASH
45.	BUS CRASH
46.	EVACUATION
47.	HELICOPTER CRASH
48.	LARGE VEHICLE CRASH
49.	PERSONNEL INJURY
50.	PRT COLLAPSE
51.	TRAIN DERAILMENT
	CHEMICAL EMERGENCY
52.	CHEMICAL SPILL
53.	EVACUATION
54.	FOOD CONTAMINATION
55.	NUCLEAR ATTACK
56.	POISON
57.	RADIATION RELEASE
58.	TOXIC MATERIAL
	UNDERGROUND EMERGENCY
59.	STEAM TUNNEL FIRE
60.	SUBSIDENCE
	OFF CAMPUS SUPPORT EMERGENCY
61.	BOMB THREAT
62.	DEMONSTRATION
63.	DISEASE
64.	DROUGHT
65.	EARTHQUAKE
66.	EVACUATION
67.	EXPLOSION
68.	EXPLOSIVES
69.	FOOD CONTAMINATION
70.	FOREST FIRE
71.	HOSTAGE
72.	INSECTS
73.	LANDSLIDE
74.	LOOTING
75.	LOSS OF WATER SUPPLY UTILITY EMERGENCY
76.	MASS BLACKOUT
77.	MINE TUNNEL CAVE-IN
78.	MULTI-VEHICLE ACCIDENT
79.	NUCLEAR ATTACK
80.	RADIATION RELEASE
81.	RIOT
82.	SNIPER
83.	UNCONTROLLED ANIMAL
84.	WATER CONTAMINATION UTILITY EMERGENCY

The utilization of a three-part identification code within an Emergency Preparedness Plan has two objectives. Such a code permits a consistent method of communicating under emergency conditions that allows orderly execution of the appropriate operations plan. Identification through a three-part code also permits "preplanning" by each of the Emergency Operations Units in order to allow maximum emergency preparedness.

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Part A outlines the nature of the emergency identified as General Emergency Condition. Part B identifies the level of the emergency or the magnitude of the emergency, and Part C identifies the type of the emergency or the specific kind of emergency involved. In order to be successful each Emergency Operations Unit must have a basic preparedness plan for each of the eight general emergency conditions shown in Figure A. Additionally, each Emergency Operations Unit must be prepared to function in accordance with the magnitude of the emergency as outlined in Figure B.

The third part of the identification code details the specific kind of emergency involved. Each Emergency Operations Unit will respond with their particular "preplan" related to that type of emergency as outlined in Figure C.

Since the emergency organization that is developed must be recognizable to the entire campus community, a functional chart of organization that is understandable is important. Figure D shows a typical chart, of what can be developed. One can readily note from the chart that "support units" are identified as opposed to "active units" under emergency conditions. Additionally, "emergency operations control" is clearly the focal point of the functional organization. One can further identify the responsibilities of each active emergency unit as well as the support responsibilities or support units. When designed in accordance with the needs of the individual campus community, a functional chart of organization can be instrumental to the success of an Emergency Preparedness Planning/Action Procedure.

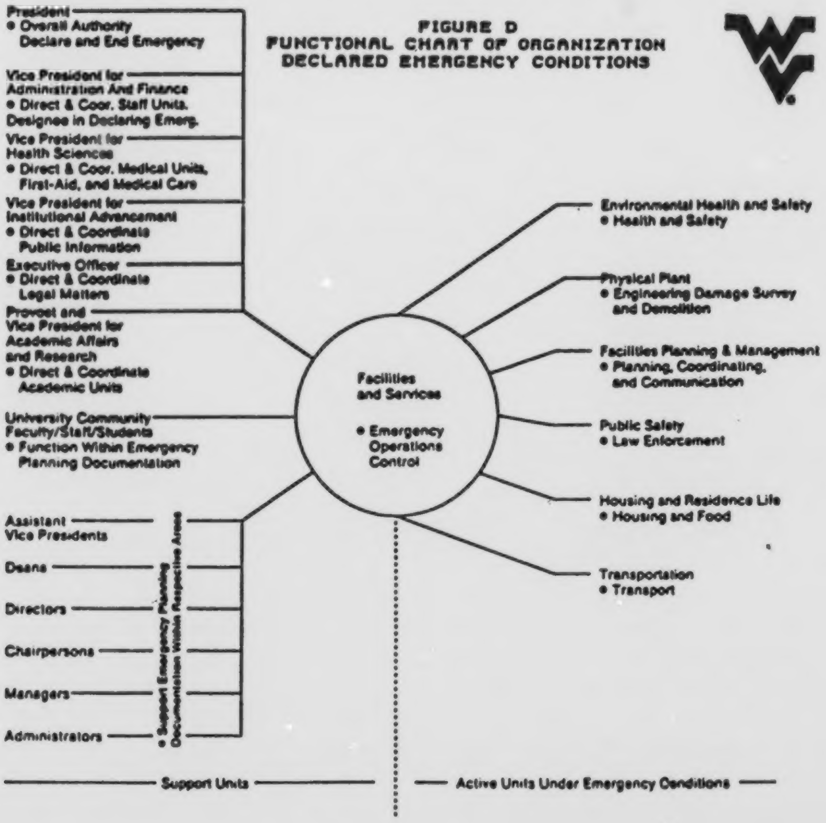
FIGURE D
FUNCTIONAL CHART OF ORGANIZATION
DECLARED EMERGENCY CONDITIONS

President
• Overall Authority Declare and End Emergency
Vice President for Administration And Finance
• Direct & Coor. Staff Units. Designee in Declaring Emerg.
Vice President for Health Sciences
• Direct & Coor. Medical Units, First-Aid, and Medical Care
Vice President for Institutional Advancement
• Direct & Coordinate Public Information
Executive Officer
• Direct & Coordinate Legal Matters
Provost and Vice President for Academic Affairs and Research
• Direct & Coordinate Academic Units
University Community Faculty/Staff/Students
• Function Within Emergency Planning Documentation
Assistant Vice Presidents
Deans
Directors
Chairpersons
Managers
Administrators
• Support Emergency Planning Documentation Within Respective Areas
Facilities and Services
• Emergency Operations Control
Environmental Health and Safety
• Health and Safety
Physical Plant
• Engineering Damage Survey and Demolition
Facilities Planning & Management
• Planning, Coordinating, and Communication
Public Safety
• Law Enforcement
Housing and Residence Life
• Housing and Food
Transportation
• Transport
Support Units
Active Units Under Emergency Conditions

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During emergencies the campus must be capable of self-reliance for a period of time. All outside resources may be essential to the recovery of their own areas of responsibility and, therefore, the resources of the University or College must be organized to provide a nucleus of essential services in order to maintain itself during this period.

Primary service units under emergency conditions are identified in Figure E.

FIGURE "E" EMERGENCY SERVICE UNITS

A. EMERGENCY OPERATIONS CONTROL - THIS PERSON/RESPONSIBILITY AREA WILL BE IN AUTHORITY IF CONDITIONS CAUSE A "DECLARED EMERGENCY" TO EXIST.

B. PLANNING COORDINATING AND COMMUNICATION - THIS FUNCTION WILL NORMALLY RELATE TO THE FACILITIES PLANNING AREA OF RESPONSIBILITY AND THE COMMUNICATIONS PROCESS.

C. ENGINEERING, DAMAGE SURVEY AND DEMOLITION - THESE ACTIVITIES ARE THE MISSION OF THE CAMPUS PHYSICAL PLANT UNIT AND SHOULD BE CARRIED OUT ACCORDINGLY.

D. HOUSING AND FOOD SERVICE - AS PART OF THE NORMAL "RESIDENT" RESPONSIBILITY, SHELTER AND FOUND MUST BE PROVIDED.

E. LAW ENFORCEMENT - A PART OF THE PUBLIC SAFETY/SECURITY.

F. HEALTH AND SAFETY - VARYING FROM CAMPUS TO CAMPUS. THIS FUNCTION IS UNIQUE IN NATURE AND RESTS WITH THE IDENTIFIED SPECIALISTS IN THE FIELD.

G. TRANSPORATION - MOVEMENT OF PEOPLE AND MATERIAL/EQUIPMENT IS A NORMAL PART OF PHYSICAL PLANT ACTIVITY.

The functions of emergency service identified should be considered the primary areas for "action" when emergency conditions exist. The responsibility and authority in these "action areas" will include the Director/Manager of each unit or appointed authority if unit responsibility does not exist. These unit heads will appoint their alternates; staff emergency crews; maintain a current roster of the crews; prepare a practical plan of emergency action for conditions outlined in Figures A, B, and C apply an up-to-date training and indoctrination program for their personnel; maintain a liaison with various community resources related to their specialty and develop and publish a list of unit personnel responsible for internal emergency preparedness in their area of responsibility/authority.

The President should be responsible for the initial declaration of a state of University or College emergency, as well as declaration to end the state of emergency when appropriate. The President should establish policy and procedures to insure an effective response to safeguard lives and property to the greatest extent possible. The Emergency Operations Control Officer should be the responsible party in authority when an emergency has been declared. They should be responsible for all direction of emergency operations and notify and maintain liaison with all campus officers. As necessary, the Emergency Operations Control Officer shall arrange assistance and liaison with those functions outlined in Figure D.

Training programs should be conducted periodically by emergency service units to insure that all personnel are familiar with their emergency assignments and are competent to execute them. Each unit head should prepare written instructions for use by their personnel in emergencies. Copies should be supplemental to the emergency preparedness documentation and made available to unit alternates for necessary action.

Joint mock drills should be conducted. The mock drills should be conducted by all units involved in emergency preparedness operations with an appropriate department acting as the lead unit. A campus-wide committee should establish criteria and act as the evaluator of performance during mock drills. The drills should be conducted on an annual basis and the performance and evaluation results should be reported by a campus-wide committee to administration and the operating units.

Understanding that specific responsibilities will vary from campus to campus, the following are recommended units with responsibility for Emergency Preparedness.

ACTION UNITS

Public Safety Department (Security)

1. Assume initial on-site command and control of emergency response.
2. Provide supplemental emergency communication between Emergency Operations Center and site of the emergency as needed.
3. Request assistance from outside law enforcement agencies as directed by the Emergency Control Officer.
4. Maintain access routes for emergency vehicles and personnel.
5. Coordinate evacuation of personnel as directed.
6. Develop the Emergency Operations Center facility.

Physical Plant

1. Maintain emergency control, coordinate emergency restoration of utilities.
2. Construct temporary facilities as needed.
3. Assist in rescue, clearance, and demolition.
4. Procure emergency water supplies.
5. Provide a damage assessment team for early evacuation
6. Conduct disaster analysis and damage assessment.
7. Provide engineering assessment.
8. Coordinate construction contractors according to the campus situation.
9. Provide transportation.

Environmental Health and Safety

1. Investigate and evaluate hazards to health and safety and advise the Emergency Control Officer.
2. Conduct liaison activities with the county health department, fire department, and other public agencies having health and safety responsibilities or services.

Facilities Planning/Communication

1. Request assistance from outside agencies as directed by the Emergency Control Officer.

2. Establish liaison with construction contractors working on campus to utilize equipment when and where necessary.
3. Assist Physical Plant with disaster analysis and damage assessment.

Housing and Residence Life

1. Coordinate all sources of food and shelter during emergency.
2. Responsible for providing shelter and food from campus resources.

SUPPORT UNITS

Vice President or Authority in Administration and Finance

1. In the President's absence, declare a State of Emergency and an end to the State of Emergency as appropriate.
2. Assure that official records of the emergency are compiled and maintained.
3. Implement emergency purchasing authority to provide emergency funding to Primary Service Units.

Provost, Vice President or Authority in Academic Affairs and Research

1. Coordinate administrative policy of Environmental Health and Safety as it affects laboratory safety.
2. Provide liaison with the various Deans in regard to emergency procedures in their areas.

Vice President or Authority in Institutional Advancement

1. Establish a public assistance center to handle inquiries relative to the emergency.
2. Responsible for public information and public relations in coordination with Facilities Planning and Emergency Control Officer.

Vice President or Authority in Health Sciences

Provide personnel and facilities for immediate first aid and medical care.

Vice President or Authority in Student Affairs

1. Direct and coordinate mobilization of student volunteers with Authority in Human Resources.

Vice President or Authority in Human Resources

Mobilize and coordinate manpower needs of the campus in emergency operations as the information is received from the Control Center.

Deans of Schools/Administrators

Each dean is responsible for the minimization of hazardous laboratory conditions that may arise as a result of the suspension of utility services or damage to facilities. Other Administrators who report directly to the President or the Vice Presidents may be requested to remain on alert and to advise the President's Office or the Emergency Operations Center as well as the Department of Public Safety where they may be reached during the State of Emergency. It is the responsibility of each administrator to assess and to report the situation of his/her unit(s) and their ability to respond to the emergency.

It is extremely important in developing an Emergency Preparedness Plan to **identify equipment and resources available** in case of need. Each operations unit is individually most capable of identifying the equipment and resources needed in their area of expertise when carrying out emergency operations effectively. Their input is necessary to compose and **maintain a complete list** of equipment and resources that are available and/or needed. The **location** of this equipment and resources is also **critical** to a **successful** operation under emergency conditions. The **location must be appropriate for prompt access** during emergency operations and should be identified in listing the equipment and resources. The lists can be compiled by "type of equipment" so that any of the operating units can readily identify equipment availability and location. As an alternate, equipment can be listed by "operating unit" identification criteria since the equipment will normally be stored at that specific facility throughout the campus.

Work on Emergency Preparedness begins with the elementary development of an **Emergency Preparedness Policy** that brings into focus the **nature, level and type of emergency**, as well as the responsibilities for each department within the Physical Plant function. It should also outline basic data on a number of key issues regarding **potential conditions, authority, "action unit" responsibility, training, equipment**, and **organization**.

Throughout our work on preparedness we have always stressed the importance of considering individual campus environments as well as the importance of participation of departments and personnel who are the experts in addressing various circumstances that arise. A great deal of information can be supplied from numerous sources who have done Disaster Planning and Emergency Preparedness Programming. While this information is transferable, to all Universities and Colleges, the particular environment and Physical Plant players involved must utilize the information provided with an understanding of the unique conditions that exist in their own environment. When this analysis process has taken place, the University or College involved will possess the data to develop an action plan for emergency operations that allows for an orderly handling process throughout the emergency, and be ready for the inevitable and unexpected disaster.

Know the potential conditions that may arise .... develop an organization that can respond to conditions .... conduct unit training and organize equipment .... with this accomplished .... Physical Plant operations everywhere can **limit the potential destructive forces of disaster**, and during the recovery period the University or College will **be equipped** to **minimize negative financial impact** and afford **maximum protection** for all involved.

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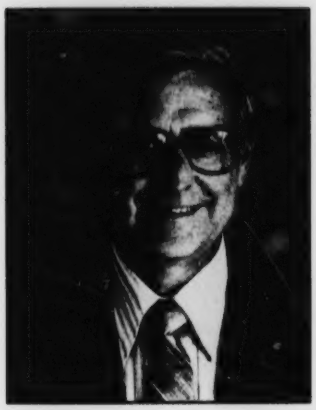

We Were Prepared: UC Santa Cruz Experience in a 7.1 Earthquake

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Having lived in California for all of my sixty plus years, I am sure I have become somewhat blase about earthquakes. It was always exciting to see the reaction of colleagues who had recently moved to the Golden State when a small trembler happened. Obviously, we long-time Californians were not that concerned. Or were we? In the back of our minds there was always the fear that this might be the "big one."

Tuesday, October 17, 1989, was my middle daughter's birthday, and as October was also the month of my birthday and our son-in-law's, we planned a family birthday get together for that evening. In order to get the barbecue going, and help my wife with preparations, I left work about 4:45 pm and arrived home a little after 5:00 pm. She was out in the backyard and I was about to light the barbecue when the earth started to shake. We immediately moved to a safe place where there are no trees or other objects which might fall on us, and watched our house try hard to shake itself apart. While we lived through many earthquakes, this to us was certainly the big one.

A possible analogy would be that of a driver who off-and-on has a few fender benders, nobody hurt, a little damage, and certainly annoying. After getting used to the occasional fender bender, finally the driver ends up in a head-on collision at about 50 mph. Perhaps I am exaggerating a bit in comparing a 7.1 earthquake to a head-on collision. This was not the case for our family, as none of us were injured, and while we did have some damage to our homes and considerable damage to our belongings, we really came through it fine.

I am sure though, the analogy would hold for those in the unreinforced brick buildings on the Santa Cruz Garden Mall, where buildings collapsed, several people were killed and a number were seriously injured. I am not sure if this 7.1 earthquake qualifies as the "big one" but for us it was certainly big enough.

We immediately assessed the damage and found that almost all of our dishes and other kitchen equipment were on the floor and our back door was blocked by items falling out of cabinets. As the car was in the garage, we decided the first priority was to "dig it out" so that it would at least be out in the driveway in case an aftershock came and more items stored in the garage rafters fell upon it. After this was done, we started digging out of the kitchen and by then our children had assessed their damage and were at our house helping out. We did manage to have dinner, namely barbecued steak, french bread, and the salad that had been prepared earlier in the afternoon.

I was fortunate that I was home when the quake happened, so that I could help clean up the first layer of debris. I then turned my attention to the campus, and as I drove through the dark city, I was thankful to see lights as I entered the west entrance of the campus. I knew the 2.5 megawatt cogeneration unit was doing its job in keeping power on to the campus during this emergency. My first stop was at the heating plant where I received a quick briefing on problems to date. The immediate problems seemed to be leaks in the hot water heating systems in two of our major buildings, which caused considerable flooding. The cogen unit was operating well and although there was a short outage when the power first went off, it had faithfully supplied power to the campus since that time, and in fact, continued supplying power throughout the next day.

I went to the emergency response center located at the campus firehouse. As the campus had a disaster plan, and as campus personnel were drilled as to their various responsibilities in case of a disaster, I found an orderly group of campus people taking charge of the disaster. The campus Fire Chief has immediate responsibility for the operation of this group, and the Chancellor and other campus administrators had reported to this location.

More than 4,000 students live on campus in residence halls. There are eight residential colleges, each consisting of dormitories and/or apartments, administrative offices, faculty offices, classrooms, and dining commons, as well as other student life facilities. Given the time of day, a large number of students were in their residence halls. It is amazing that there was no loss of life, and only seven minor injuries. This successful record was due in part to information given to students in earthquake preparedness training, and to the seismic design of the campus facilities.

The first order of business was to examine all residence halls to determine building safety so that students could return to their rooms. As power remained on, it was possible to feed these students outside their residence halls.

October 17th was quite warm, which is unusual for Santa Cruz, as we often have cold weather in October and almost always have cold evenings.

The students brought blankets and other personal belongings from their rooms, and enjoyed the balmy weather within the open spaces of their various colleges. Campus Facilities' architects and engineers started immediately to examine residence halls for structural damage. Only two residence halls were considered not safe to enter, and the majority of students slept in their own beds that night. A request for help from UCLA was immediately responded to, and that campus sent two structural engineers, a hazardous clean-up team, a medical team, and additional police to the campus immediately.

The next day, the structural engineers examined the questionable residence halls and certified their safety. The structural engineers from UCLA were joined by structural engineers provided by the State Office of Emergency Services, and, accompanied by Campus Facilities' architects and engineers, all major buildings on campus were quickly checked for structural damage. Because the major science buildings could not be entered until cleared by Environmental Health and Safety, it was not possible to examine these buildings until clearance was obtained.

Immediately after the quake, Environmental Health and Safety teams made thorough examinations of all science buildings. The UCLA Hazardous Waste Team was joined by teams from the Santa Barbara campus and the Davis campus, and it was possible to make a thorough investigation of all of our science buildings during the next three days and to remove dangerous materials.

Thimann Laboratories, a wet laboratory building completed in 1965, had been rated poor seismically, and seismic corrections to that building were under construction. The work was in the early stage, and in fact, what work had been done actually weakened the building. The structural design engineers were on campus on Wednesday to make a thorough examination of Thimann Laboratories and of Natural Sciences 2, a physics and chemistry building which was completed in 1966. Thimann Laboratories was certified for occupancy, however, potentially serious problems were observed in Natural Sciences 2. It was found that where the beams join the columns, excessive spalling had resulted and the engineers were concerned that a heavy aftershock might cause failure. It was necessary to provide heavy timber shoring so that it could be occupied, and the engineers started a complete analysis of the building in order to provide recommendations for permanent corrective action. This was the only building on campus which could not be immediately occupied for structural reasons, and which required additional shoring.

The campus has written a Disaster Plan and established a Disaster Preparedness Committee as a standing committee. The Fire Chief chairs this committee, and representatives from Environmental Health and Safety, Telecommunications, Campus Facilities, Housing, the Science Divisions, Public Relations, and other campus constituencies are on this committee. The campus plan is based on having individual plans for each of the campus units with building coordinators who are acquainted with the emergency features of their buildings. All Campus Facilities personnel, including Physical Plant personnel and Physical Planning and Construction personnel, have assignments which they are to assume during disasters.

The campus is fortunate in having its own fire department and fire station. While this department is minimally staffed and equipped by city standards, it does provide first fire fighting response, and medical response in case of emergencies. The fire station is the Emergency Command Center, and all campus personnel know that they can report to that location and obtain briefings and assignments as to necessary action. This system functioned well with the Chancellor and Vice Chancellors attending all of the briefing sessions, and in fact, being available at the center to assist in directing the emergency operations.

On Wednesday, October 18, 1989, the Emergency Response Team met at the Command Center, and after the Chancellor heard a briefing from various units, decided that classes would resume on Monday, October 23, 1989. This decision was based on projections of completing hazardous waste review and clean-up by that time, and the ability to clean and repair the majority of the classroom spaces on campus. On Thursday, October 19, 1989, faculty and staff were encouraged to return to the campus and, except for two of the science buildings which had not been cleared because of toxic contamination, these persons were able to return to their offices and gradually put things back to normal.

Damage sustained consisted mostly of falling objects, such as bookcases, laboratory equipment, and library shelving. In the main library, more than 50,000 books were on the floor and a number of the stacks failed structurally. These were braced with rods secured by hooks in the stack structure, which is supposed to give lateral support. During the shaking, the hooks came loose and the shelves failed in a longitudinal direction.

The main chemical stockroom had been provided with restraints on all of its shelves and only one bottle fell on the floor. Unfortunately, these restraints were not used universally within research laboratories, and a large amount of chemicals and equipment fell to the floor, causing serious concern for toxic hazards as well as breaking a great deal of valuable laboratory equipment.

In some areas, large clerestory windows broke and there was considerable glass damage in these buildings.

Asbestos raised its ugly head and caused serious concern in the clean-up effort. One of the buildings had asbestos within the fan plenums. A contract had been let for asbestos removal, however, this work had barely begun. It was fortunate, however, that it had begun because the campus had at its disposal a qualified abatement team and a consulting industrial hygienist. The first order of business was to remove loose asbestos material within these plenums before the fans could be turned on. This was also a laboratory building, and it was necessary to clear it for toxic hazards; all of this work was completed by about Friday, October 20, 1989.

The campus student services building has a sprayed on asbestos material on the ceilings. While this material is not considered friable under normal circumstances, an earthquake causes a great deal of white dust to appear on all surfaces and upon the floor. It was necessary for the abatement team to clean up this material before these spaces could be occupied. Even after clean-up took place, and the area was certified to meet health requirements by the industrial hygienist, a number of staff members were deeply concerned about the asbestos hazard. This is another excellent reason for campuses within earthquake areas to remove all asbestos ceiling material even if it is not considered hazardous at the present time.

With normal operations resumed on Monday, October 23, 1989, the Campus Facilities Work Order Desk was flooded with repair requests and observations of possible damage. Each of these was recorded and an Inspector/Planner/Estimator was dispatched to review the situation and to report back. Where it appeared that possible structural damage may have occurred, an architect or a structural engineer was dispatched. No serious structural problems were observed; however, a large number of cracks, spalling of concrete, and other types of damage were observed.

The campus was required to provide a "rough" estimate of damage and extra cost caused by the earthquake. As this number was due late Sunday afternoon (October 22, 1989), it was rough, and total estimate was between twelve and eighteen million dollars.

The State Office of Emergency Services (OES) in conjunction with the Federal Emergency Management Agency (FEMA) set up offices in Santa Cruz, and invited representatives of all public agencies to a meeting on Wednesday, October 25, 1989. The campus applied for such aid, and FEMA inspectors visited the campus starting November 3, 1989. All departments were requested to assemble costs to date of actual expenditures during the first emergency phase, and to provide listings of all damaged equipment. Campus Facilities was responsible for determining structural damage, and of pointing this out to the FEMA inspectors.

Campus Facilities architects and engineers were assigned to the various buildings on campus, and attempted to inspect all buildings prior to the FEMA inspection team arrival on campus. These architects and engineers were responsible for assisting the FEMA teams in inspection, and accompanied these teams along with a representative of the unit involved.

By the end of the first week, almost all emergency action had been completed, all buildings except for Natural Sciences 2 were in use, and the campus was generally back to normal.

We shifted into the next stage of carefully assessing the damage, arriving at estimates for permanent repairs, and obtaining funding through the State and Federal sources. Of equal importance, was the of review of actions taken on the night of the emergency and the days following in order to determine what went well and what could be improved.

Following are lessons learned from this earthquake, and reasons why the campus responded well to the emergency, along with suggestions for improved response in the future.

1. The Santa Cruz campus can survive a 7.1 earthquake with the epicenter located less than twelve miles from the campus with minor injuries, no loss of life, and no major structural damage.

2. The fact that the campus had a disaster plan, with the Disaster Preparedness Committee charged with the responsibility of disaster planning and training, and a preplanned emergency control center, contributed greatly to the immediate response to the disaster, and the ability of the campus to get back into operation in very short order. More training is needed, especially for residential students and college staff and faculty.

3. The Regents' policy for strict adherence to seismic codes, the insistence on independent seismic review of major projects, and the fact that a number of campus buildings had undergone seismic corrective work, provided safe buildings which minimized physical injury and property damage.

4. The availability of emergency power from the cogeneration system which provided for the ability to feed and house students, and to provide for immediate structural inspection of campus buildings, was essential in this operation.

5. The factor of fear and emotional distress became apparent both during the emergency and especially in the days that followed. While the earthquake itself was a traumatic experience, the large number of aftershocks kept people on edge emotionally for the first week after the disaster and in some cases, for weeks thereafter. Through the campus counseling center, counseling groups were established for students, faculty, and staff immediately after the disaster.

6. The need to structurally fasten equipment such as bookcases, gas cylinders, and other large pieces of equipment including fans and other mechanical and electrical equipment was well known before this emergency; however, in many cases was not accomplished. The structural fastening of this equipment and the providing of restraints on shelving and cabinets is relatively simple and well worthwhile for areas within earthquake country. There was considerable damage to scientific equipment; library shelving failed and books were everywhere.

7. Toxic hazards cause great concern in the aftermath of an earthquake. All laboratory buildings must be carefully examined by professional Environmental Health and Safety personnel using rescue breathing apparatus to determine the extent of hazardous materials and to provide for clean-up of

these materials. Asbestos materials will be loosened during an earthquake and these must be carefully cleaned up and the areas tested before occupancy.

8. There is an immediate need for help from others, including structural engineers to assess building safety, environmental health and safety personnel to supplement campus personnel, and the possible need for emergency medical personnel. Our sister campuses responded immediately and contributed greatly to our efforts.

9. There is a need for better communication at all levels, both within the campus and outside the campus. The campus radio station should be more effective as an emergency broadcasting center. There was a virtual news blackout as far as the campus was concerned and parents could not find out if their students were safe.

10. The campus is isolated from the community and must review staffing and equipment needs of the Fire Department, the Environmental Health and Safety Unit, the campus Health Center, and other units needed in an emergency. Consideration must be given to providing adequate emergency equipment and installing additional water supply for the campus.

Indoor Air Quality of Buildings and Schools

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Introduction

The "Sick Building Syndrome" has become an increasingly acknowledged health and comfort problem in schools as well as other public and commercial buildings. Buildings are characterized as "sick" when its occupants complain of acute symptoms such as headache, eye, nose and throat irritation, dizziness, nausea, sensitivity to odors, and difficulty in concentrating. The complaints may become more clinically defined so that an occupant may develop an actual "building related illness" that is believed to be related to indoor air pollutant exposures. Relief from these symptoms can only be achieved by leaving the building, and in some cases, a prolonged recovery time may be necessary.

New and recently remodeled buildings appear to be particularly vulnerable to "sick building" related problems. In fact, The World Health Organization (WHO) has estimated that up to thirty percent of new and remodeled office buildings may experience problems associated with this syndrome. Such problems may be the result of a myriad of contributors such as inadequate ventilation, chemical pollutants emitted from inside activities and materials, chemical pollutants being brought into the building from outside sources, and biological pollutants from both internal and external sources. Other contributing factors may include the actual usage and operation of the buildings. The buildings themselves may be used or operated in ways unforeseen by those who designed them.

The occurrence of "Sick Building Syndrome" may become a significant economic and personal burden on both the owners and occupants of afflicted buildings. The impact of increased occupant absenteeism, reduced worker morale, reduced occupant productivity, increased owner liability, and the financial impact of locating and correcting causes of the problems will affect all involved.

As public awareness of indoor air quality (IAQ) issues continues to grow, pressure increases on schools and other public buildings to provide "safe indoor environments" for occupants. Currently, there are no regulated standards for indoor air quality in schools, but there are certain guidelines for pollutant exposures and ventilation rates issued by several government and consensus professional organizations. Since children and young people are thought to be particularly vulnerable to health effects of chronic pollutant exposures, every action should be taken to provide acceptable air quality using currently available guidelines and corrective actions.

Indoor Air Quality Problems

IAQ concerns are generally related to comfort parameters or elevated pollutant levels, and each of these is dependent on the operational characteristics and effectiveness of the ventilation system. Frequently encountered problems in buildings and schools are given in Table I.

Ideal comfort satisfaction is difficult to achieve, since it is related to individual subjective responses. However, adverse conditions can affect productivity and the learning environment for both staff and students. Elevated pollutant levels can impair human performance by contributing to a simple, but continuous, irritation or they can increase the likelihood of a more serious health threat such as cancer. Pollutants are of two general types, particles and gases, the most common of which are presented in Table II.

The numerous sources of indoor pollutants include: outside air; indoor activities such as tobacco smoking, cleaning, cooking, refinishing/refurbishing, science experiments and operation of business machines; internal construction and furnishing materials such as pressed wood, floor coverings, wall coverings, furniture, school supplies, ventilation duct lining and ceiling tiles; biological pollutants such as fungi, molds and bacteria generally arising from poorly maintained ventilation (HVAC) systems and water damaged materials. Pollutants are all directly or indirectly "man-made" except for radon. Radon is a naturally occurring pollutant emanating from underlying soil and rocks, and it enters buildings primarily through cracks, drains, and ventilation openings.

Most pollutant levels are dependent on the rate of ventilation and its effectiveness within the building. Lack of adequate outside dilution air into the building will allow pollutant levels to increase in concentration as they are generated. In fact, carbon dioxide levels are used as an indication of poor outdoor air ventilation rates. Many sick building studies have shown that as the carbon dioxide level increases, the number of complaints within a building will also increase. This is shown in Figure 1. Since carbon dioxide is primarily a respiration product of the occupants of a building, it increases during the day with human activity. However, adequate outside air delivery will dilute and flush it out. Otherwise, it will increase and peak at maximum activity times.

In addition, poor mixing or non-effective distribution of building supply air will encourage the presence of stagnant areas where pollutant concentrations will rise. Improperly balanced HVAC systems will also encourage these stagnant areas and, in some cases, if negative pressure develops within the building, outside pollutants such as vehicular exhaust and radon can rapidly infiltrate into the building.

Health Effects

Currently, there are no regulated indoor air quality standards for schools. However, there are numerous exposure guidelines established for indoor air by various governmental and professional agencies. Some of these guidelines are given in Table III. Potential human health effects are a factor of many parameters including age, occupation, health status, sex, personal habits, and work activities. The younger age groups, especially elementary age children, are thought to be more vulnerable to adverse effects because of their higher respiration rate per unit body weight and their undeveloped ability to communicate concern.

Health effects are classified as acute or chronic. Acute generally manifest themselves, after brief exposures, such as the irritation of mucous membranes resulting in nose and eye irritation. Chronic effects develop over time such as soft tissue damage and cancerous manifestations. Some common health effects related to IAQ pollutant exposures are presented in Table IV.

Control Methods

Specific methods are available for preventing or reducing IAQ concerns. These include:

1. Providing adequate and effective ventilation. This includes complying with the ASHRAE STANDARD 62-1989. The proper amount of outside air must be brought into the building and the air must be effectively distributed to the breathing level zone of the occupants. In addition, air intakes and exhaust systems must be designed so that polluted air is not brought into the building. Those activities which generate high loads of pollutants such as tobacco smoking areas and printing/graphic areas should be exhausted directly to the outside.

2. Insuring that safe, low emitting materials are used in new construction and remodeling activities. These include construction materials and furnishings such as wallboard, floor coverings, wallcoverings, paints, adhesives, duct lining, ceiling tiles, furniture, etc. These materials should be pre-tested or certified to be low emitting.

3. Enforcing a well documented and scheduled HVAC operational plan which includes changing of filters, cleaning of air handling rooms, cleaning of condensate drip pans to discourage the growth of microbial debris, and assuring proper operational performance.

4. Removing or correcting existing sources of indoor pollutants. Special filtration, encapsulation and substitution are common techniques.

5. Educating the staff and building occupants concerning IAQ, sources of pollutants and their effects, and control measures.

IAQ Management Program

With the growing concern and proliferation of litigation concerning IAQ, school administrations should formulate an IAQ management program. Not only is there the basic concern of poor IAQ affecting and impairing one's health, but a poorly managed IAQ episode can cause significant and unwarranted disruption to the educational process. Components of a good management program should contain preventative measures as well as procedures for addressing acknowledged concerns and complaints. Suggested components include:

1. A well defined communication and public relations program to address IAQ concerns. Experience has shown that acknowledgement of a potential problem and fast response is vital;

2. A building inspection program for identifying potential IAQ problems and sources in existing, new or leased buildings;

3. A defined investigative program to address IAQ complaints;

4. Preventative specifications encompassing ventilation and pollutant source control for new building design and remodeling activities;

5. A building maintenance and operational plan addressing preventive IAQ measures; and

6. A training program in IAQ issues for management, educational and facilities support staff and occupants.

With today's knowledge of IAQ and technological advances, a well designed and properly executed program should prevent IAQ problems within most buildings and institutional facilities.

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TABLE I

FREQUENTLY ENCOUNTERED IAQ PROBLEMS IN PUBLIC BUILDINGS AND SCHOOLS

COMFORT

- high or low temperature
- high or low humidity
- temperature variations
- air flow variations
- odors

VENTILATION

- HVAC system
  - inadequate fresh air intake
  - inadequate air delivery to occupied spaces
  - improper air flows
  - fans/blowers improperly wired
  - improper cleaning materials such a organic solvents and biocides
  - dirty air handling rooms
  - improper air filtration
  - inadequate preventative maintenance
  - air delivery obstructions
  - inadequate local exhaust of certain activities

ELEVATED POLLUTANTS

- Formaldehyde from activities such a biological labs or materials as pressed wood and glue
- Volatile organic compounds as toluene from synthetic materials, cleaners, printers, paints, etc. and activities such a renovating, science labs, auto repairs
- Particles from tobacco smoke, dust and dirt, motor vehicle exhaust, welding, bioaersols
- Inorganic gases such as carbon monoxide and nitrogen oxides from combustion sources as furnaces, boilers, heaters, and cooking activities
- Bioaerosols such a fungi and bacteria from cooling towers, dirty HVAC systems and water damaged materials.

TABLE II

MOST COMMON INDOOR AIR POLLUTANTS

PARTICLES

Environmental Tobacco Smoke (ETS)
Dust/Dirt (as silica)
Asbestos/Mineral fibers
Allergens (pollen, fungi, insect parts and feces)
Pathogens (bacteria and virus)
Radon Decay Products

GASES

Formaldehyde (CHOH)
Volatile Organic Compounds (VOCs)
Carbon Dioxide (CO_2)
Carbon Monoxide (CO)
Nitrogen Oxides (NO_x)
Radon (^{222}Rn)
Ozone (O_3)
Pesticides

TABLE III

GUIDELINES FOR SOME IAQ POLLUTANTS

Pollutant	Concentration	Remarks
Asbestos	0.2 fibers/cm^3	OSHA standard set in July, 1986.
	0.1 fibers/cm^3	OSHA action level requiring monitoring programs; typical background levels in outdoor ambient air in urban areas are 0.00007 fibers/cm^3.
Carbon Dioxide	1000 ppm	Japanese standard for buildings with floorspace exceeding 3000 M^2 and HVAC system.
	1000 ppm	ASHRAE recommended level for human comfort.
Carbon Monoxide	9 ppm	National Ambient Air Quality Standard average of 8 hours.
Formaldehyde	0.1 ppm	ASHRAE recommended limit based on comfort criteria which should protect all but hypersensitive individuals.
	0.4 ppm	HUD Standard for pressed wood products used in mobile homes to prevent formaldehyde in indoor air from exceeding 0.4 ppm.
Nitrogen Dioxide	0.05 ppm	Annual National Ambient Air Quality Standard.

TABLE III (continued)

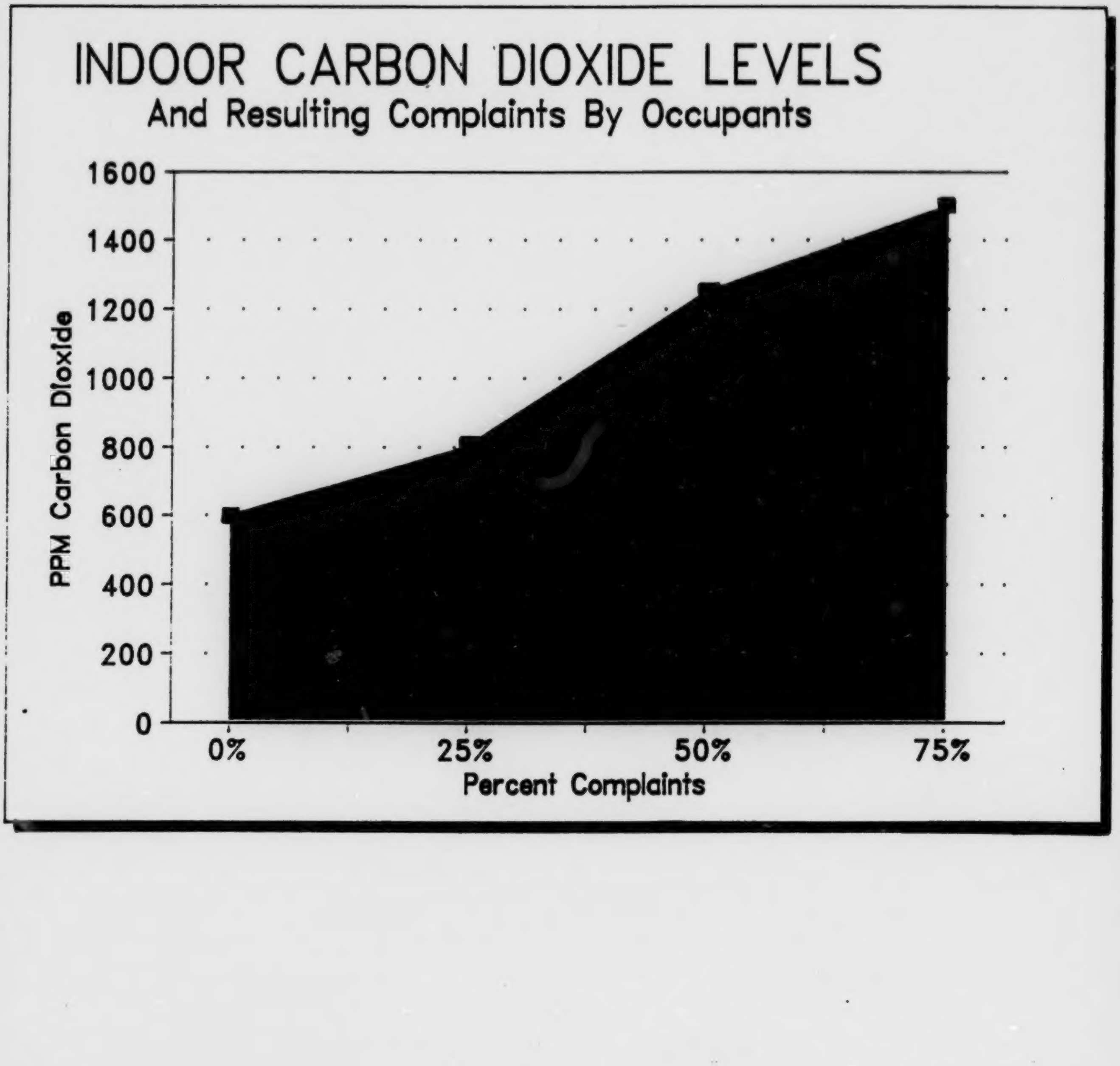
Pollutant	**Concentration**	**Remarks**
Ozone	0.08 ppm	Level of concern in World Health Organization criteria documents.
	0.12 ppm	National Ambient Air Quality Standard averaged over 1 hour.
Particulates	50 $\mu g/m^3$	National Ambient Air Quality Standard annual geometric mean.
	150 $\mu g/m^3$	National Ambient Air Quality Standard 24 hour average mean.
Radon	4 pCi/L	U.S. Environmental Protection Agency technologically achievable target level.
	8 pCi/L (0.04 WL)	Remedial action level recommended by the National Council on Radiation Protection and Measurements.
Termiticides	1.0 $\mu g/M^3$ (Aldrin) 5.0 $\mu g/M^3$ (Chlordane) 2.0 $\mu g/M^3$ (Heptachlor) 10 $\mu g/M^3$ (Chlorpyrifos)	Recommended by the National Academy of Sciences Committee on Toxicology.
Volatile Organic Compounds	1-5 mg/M^3	Lars Molhave study levels suspected of causing sick building syndrome symptoms in some individuals. U.S. EPA Guideline.

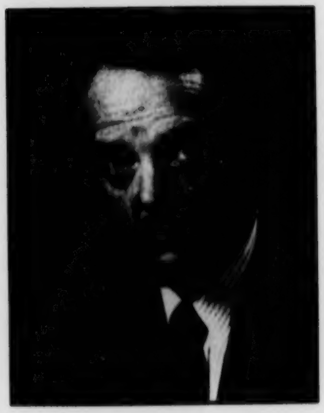
TABLE IV

SOME COMMON POLLUTANTS AND THEIR HEALTH EFFECTS

Bioaerosols	
Bacteria	Legionnaires Disease
Molds	Allergic, Dermatitis
Pollen	Allergic
Carbon Monoxide	Dizziness, Lethargy
Formaldehyde	Eye, Mucous Membrane Irritation
Fibrous Insulation	Dermatitis
Ozone	Respiratory Problems
VOCs	Dizziness, Loss of Balance

FIGURE 1


INDOOR CARBON DIOXIDE LEVELS
And Resulting Complaints By Occupants
1600
1400
1200
1000
800
600
400
200
0
PPM Carbon Dioxide
0%
25%
50%
75%
Percent Complaints



Resolving IAQ Problems in a New University Library

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Memorial University of Newfoundland

INTRODUCTION

The 1970's saw tremendous changes in world energy markets which had major effects on how building's systems were to be designed. From 1973 to 1974 the price of crude oil quadrupled over its level in 1972. The catalyst for this was the Arab Israeli war which broke out in October 1973. When the war broke out OPEC ceased bargaining with major oil companies and used oil as a weapon in the war. OPEC announced an increase in the tax reference price, implemented cutbacks in production and put an embargo on oil exports to parts of North America and Europe. Panic resulted: the price of oil traded rose from under $3 U.S. a barrel to over $10 U.S. Governments of consuming countries began to examine ways to deal with this tremendous increase and encourage building owners and designers to effect measures to reduce energy consumption. It was in this climate that Memorial University of Newfoundland embarked on a construction project to build a new Library to replace its old and overextended original Library facility.

On the subject of climate; there is a common misconception that St. John's, NF is 'way up north'. For your information St. John's is further south than the following major cities, London England, Dublin Ireland, Paris France, Milan Italy and Portland Oregon. However, notwithstanding this it does not enjoy the same clement weather as some of these cities. St. John's weather is greatly influenced by the sea. Winter is somewhat temperate, while the spring and summer weather is influenced by the cold Labrador current sweeping down between mainland Canada and Iceland. As a result of this, spring tends to be late in arriving and summers tend to be relatively short with extremes of temperature being the exception. Therefore, traditionally buildings in Newfoundland have not been air conditioned. This is particularly so since large buildings with interior spaces were also the exception and cooling of building space was generally effected by operable windows or by ventilation systems using untreated air.

In contemplating a new Library facility for the University in 1974 advances in Library conservation technology made during the late 60's and early 70's were to be incorporated into the Library design. Early and rare book paper was made with cotton based fibre and was relatively inert whereas from the late nineteenth century on paper was made from wood based fibre and was inclined to be acidic rather than neutral. The impact of climate on acid paper was not fully understood for a number of years until analysis of some large collections indicated that indeed not only rare books needed to be protected but that newer booked also needed consideration. Consequently the new library was to be designed as a tight, fully climate controlled building with no operable windows.

At the same time the oil crisis was spurring on new advances in building systems to effect more energy conservation and accordingly it was decided to incorporate the latest suitable technology in this regard.

THE BUILDING

The Queen Elizabeth II Library is a 200,000 square foot concrete building of 5 storeys.

The ground floor is essentially below grade and was originally intended to hold a map library, some support areas, seminar and lecture rooms and a staff/faculty lounge. Of course in a situation not unknown to administrators the map library was moved to the 5th level and a bookstore was put in its place etc, etc., thereby changing dramatically the space usage.

The second level houses the administrative office and reference areas. All offices were designed on the open plan with no dividers of any sort.

The third level houses the Rare Book Centre for Newfoundland Studies, stack areas and reading rooms.

The 4th and 5th levels house stack areas and reading rooms.

THE BUILDING SYSTEMS

Climate control for the building is effected for the most part by air systems. There are some perimeter heating systems in areas of high glass but as these areas have not presented a problem they will not be addressed further in this paper.

A variable air volume (V.A.V.) system was used in the building with terminal reheat installed in the VAV boxes servicing each designated zone. In all staff areas a T-Bar ceiling was installed and air distribution is by linear slot diffusers. The reading room areas use conventional linear diffusers for air distribution while the stack areas which do not have a ceiling have exposed duckwork and use conventional supply grilles for distribution. The air systems supply approximately 120,000 CFM at 55°F air to the building and have a minimum fresh air setting of 20 percent nominal. The building is fully air conditioned by a centrifugal chiller and humidity is provided with steam humidifiers. In addition all major air systems accomplish heat reclaim using a Q-pipe system.

The VAV Boxes are sequenced as follows:

Heating Mode

On a call for heating the damper in the VAV box proceeds to close and can vary from 100 percent to 40 percent of the design air volume. If reducing the air volume does not satisfy the thermostats, when the box damper is at its minimum position, the boxes heating valve commences to open providing hot water to the reheat coil.

Cooling Mode

On a call for cooling the valve on the heating coil initially closes. If the thermostat is not satisfied by this the damper on the box proceeds to open between 40 percent and 100 percent until the space is satisfied.

A final point to note in regard to the building systems is that in order to provide the optimum conditions for the books, the space temperature was to be 68°F with an R.H. of 50 percent. Locked thermostats were installed under the construction contract, set at the design set-point.

THE BEGINNING OF THE PROBLEM

Construction of the new building began in the summer of 1979 and was completed in the fall of 1981 with the space being occupied in January 1982.

From the first day that people walked into the building the problems and complaints began. The old Library had a 100 percent fresh air constant volume ventilation system. Everybody had an office with operable windows and everybody had their own thermostat to control a cast iron radiation heating system. If you got too hot you opened a window; to cold you jacked up the thermostat. In many instances both heating and cooling methods were employed simultaneously. The mere fact of having to change office and building location was trauma enough, but the new building had no individual offices no operable windows, no cast iron radiators, no individual thermostats and then to add insult to injury you couldn't even adjust those thermostats that were provided. The grumbling started.

Our Department of University Works, in the flush of success of having completed the building on schedule and within budget dismissed all grumblings with the innocent attitude that they emanated from change in surroundings and what's more, the Users should be thankful to have such a modern new facility to work in.

THE PROBLEM CONTINUES

While it was at a later stage that indoor air quality became an issue, the building slowly became the major source of complaints regarding comfort conditions on the University. After a year and a half of persistent grumbling it became obvious that University Works position that the building was ironing out its kinks could no longer be reasonably pursued. Most complaints at this stage pertained to space temperatures of 68°F being too cool and at the earnest behest of the Librarian who was fielding all the complaints, the thermostats were unlocked. Initially this move was met with applause, but it quickly became apparent that other problems were generated. In the open office areas where different individual climate requirements clashed, the thermostats went up and down continuously thereby creating horrendous draft problems caused by vertical layering. The Department of University Works said "I told you so" and advised the Users that they were the manufacturers of their own discomfort. This would have been about mid 1984 and for awhile, at least, the complaints died down. University Works was satisfied that the problem was resolved or that at least the complaints would cease. However during the winter of 1985 complaints began again and it is at this stage that Indoor Air Quality, I.A.Q., began to be mentioned. The symptoms were classical; dryness, sore eyes, itchiness etc. University Works explained to the Users that of course this was to be expected. When you raise the temperature you lower the relative humidity, R.H. This was illustrated to the Users using psychrometric charts and the building's design parameters of 68°F, 50 percent R.H. Having unlocked the thermostats, some areas of the building were at 76°F to satisfy individual user's comforts resulting in corresponding lowering of the R.H.; hence the discomfort. While the Users "bought" this to a certain extent, nonetheless complaints persisted. Finally University Works agreed to retain a consultant to carry out a survey of the building in relation to (a) air quality and (b) occupant comfort. Unfortunately, in advising the Library of the retention of the Consultant, University Works gave the impression it was retaining the Consultant despite its own feeling that no problem existed.

THE CONSULTANT'S REPORT

Consultants were retained by University Works in late fall of 1985 and conducted their investigation over a 2 month period. The study took the form of interviewing various staff members who had complained but no standard forms for registering complaints were used. In addition all air handling systems were checked for operation as were all thermostats and V.A.V. boxes in the areas from which complaints emanated. The Consultant's report submitted in early 1986 identified a number of areas which required adjustments to be made to the air volumes delivered and in some cases direction patterns to be changed. In fact the report was a sound technical document. Unfortunately, a number of incidents which occurred during the investigation of the building once again were detrimental to solution finding.

Because the Consultant did not use standard forms in evaluating each compliant, but rather took notes, the Users gained the impression that once again, they were not being taken seriously. They felt that an honest effort was not being made to recognize that problems existed and that their complaints of health related effects were not being given due credibility. There was no question that by that time a deep seated mistrust of management was installed in virtually all the Library staff.

It should also be understood that while University Works may not have appeared to give sufficient credence to the problems, it genuinely felt that all investigations carried out verified that while there might be air distribution problems, no measurable evidence whatsoever surfaced of air quality problems. During 1985 and 1986 various series of tests for CO_2 concentrations were carried out with no readings above 700 p.p.m. being measured. Fresh air damper settings were checked and it was found that with a minimum nominal setting of 20 percent the building could sustain an occupancy load of 1600 people which exceeded the projected maximum occupancy. The Consultants report was provided to the Users along with copies of University Work's CO_2 readings. The Users were advised that all recommendations of the consultants report would be implemented and that further, as the Consultants had indicated that more testing should be carried out on the building's R.H., University Works would install a recording thermostat and R.H. indicator in various areas of the Library to provide an overall picture of the situation. In addition the Provincial Department of Labour were asked to come in and examine the building. Provincial officials advised that the building was receiving adequate fresh air but that R.H.

levels were somewhat low and needed to be raised. University Works readings corroborated this. By late 1987 all of the building systems were considered to be operating to their optimum and the Users were accordingly advised.

THE CRISIS

Over the next year or so the wrangling continued. At this stage complaints were still surfacing sporadically. The University's Departments of Labour Relations and Human Resources had gotten involved through various employee committees and unions. On these Departments raising the problems with University Works they were advised that no evidence of problems had been manifested and accordingly - no problem. In this instance Labour Relations and Human Resources were very supportive of University Works and the grumblings were stonewalled.

Finally a number of instances occurred in the spring summer and fall of 1989 which led to the crisis. Threats of walkouts, strikes etc. were issued unless the problems were resolved with two particular instances bringing the matter to a head.

During the spring of 1989 the R.H. in the building on a number of occasions shot up. Various adjustments were made to the free cooling portion of the air handling systems and with the luck of a sharp fall in outside temperature the building R.H. stabilized. This had happened before but with the militant mood of Users much ado was made about it this time. University Works reassurances by this time held very little water and when there was a system malfunction during July of 1989 the unrest grew. Angry confrontations between University Works and Users occurred. University senior administration got involved and finally it was mutually agreed to have an I.A.Q. specialist retained to do a building survey. Things were at such a low ebb that the Users would not accept the such survey would be done by a local company but an out of province consultant would be required to provide an objective report uncoloured by input from University Works. Such a report was commissioned in the Fall of 1989.

Pending such an investigation University Works assigned one of its own engineers to the problem on a full time basis to prepare documentation and information requested by the I.A.Q. specialist. Close examination revealed a designed system operation which, it turned out, had been the result of our fall and spring high humidity and high temperature control problems.

The HVAC systems are set up with a "free-cooling" package. When the outside air temperature rises to 50°F then the fresh air dampers fully open and the building is serviced by 100 percent fresh air. This is, however, an override to this mode whereby if the supply air goes above 65°F or if the R.H. of the return air goes above 60 percent, then the air system recognize that the "free-cooling" mode is no longer capable of cooling the building or maintaining the proper R.H. and they call for mechanical cooling while at the same time closing the fresh air dampers to the minimum position. The equipment operators had been instructed that the mechanical cooling equipment was not to be run until the outside air temperature reached 65°F. Therefore in spring and fall, on warmish humid days the system operation exacerbated the problem and caused building temperature and R.H. to rise alarmingly and uncontrolled. This situation was rectified by having an alarm ring in at the central control room whenever the supply air temperature exceeds 65°F or the R.H. of the return air exceeds 60 percent. The problem was caused by a certain lack of understanding of the system's operation by its operators which if it had been identified 7 years previously would have saved a lot of grief.

THE REPORT AND (HOPEFULLY) THE RESOLUTION

When the I.A.Q. consultants arrived to do their investigation University Works handed them over to the Users with a carte blanche. The Users became the clients and University Works took the position of being a source of technical information to the consultants. The consultants arranged numerous meetings with the users and provided them with standard forms on which to outline their concerns or complaints. I guess it's fair to say that for the first time the Users felt that they would get a fair shake and from University Works point of view, it seemed that a new spirit of cooperative endeavour was the order of the day. The Consultants spent a week exclusively at the service of the Users and a summarizing meeting was held with the Users, Consultants and University Works at the end of that time.

The initial results of the survey were discussed with heartening results for all. From the Users point of view numerous problems were identified with the air systems in the areas of concern and from University Work's standpoint it did not appear that a problem with I.A.Q. existed. Rather the problems related to controls and what appeared to be a lack of maintenance of same. When the final report was received the following areas of difficulty were identified and the appropriate corrective action is described

1. Communication: Not surprisingly to those who have read this paper, the consultants recommended that a proper communication procedure for reviewing, addressing and responding to complaints be implemented and followed, this has been done.

2. Readjust VAV boxes: What had happened over the years was that maintenance and controls personnel in an effort to try and create micro climates in open areas to satisfy individual preferences had actually fouled up the system for most. For

example if somebody complained of too much draft the maximum setting on the V.A.V. box would be an manually set at 40 per cent open and left that way. As a result the individual was either too warm in the summer or complained of lack of fresh air. Likewise people who complained of lack of fresh air had their V.A.V. boxes manually set at 100 per cent open. With 55°F air being poured into the space whenever the space was not calling for heating, drafts were evident.

Accordingly all V.A.V. boxes were reset to their design setting.

3. Recalibrate and properly position thermostats: All thermostats were recalibrated and those that were located over computers or photocopiers etc. were relocated.

4. Rebalance air systems: University Works carried out a survey of all staff occupied areas of the building to ascertain the amount of fresh air being introduced to each area and based on this established an occupancy level. Where there is insufficient fresh air being introduced either staff will be relocated or more air will be introduced.

5. Raise Relative Humidity: The consultants reported that the building relative humidity was excessively low and should be raised to the designed 50 percent. An examination of the steam humidifiers indicated clogged nozzles to be the rule. As a result the humidifiers were going out on high presume and resetting themselves in a continuous cycle. University Works has reviewed the overall humidication systems and their capacity for the building and will be making necessary changes.

THE SUMMARY

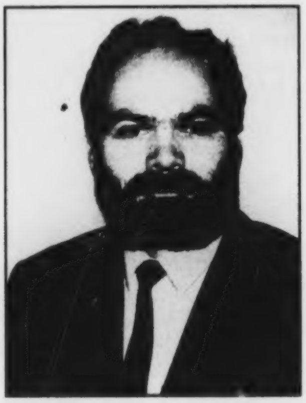
It would be nice to be able to report that the story ended at this point happily everafter. Unfortunately this is not the case and it appears that University Works may continue to reap the results of what may have been a somewhat misguided condescending approach to a problem. Users today are considerably more sophisticated and educated that those of 7 years ago and as a result, concerns and doubts generated about the Library by the Users continue. Insofar as it took 7 years to finally address the problems, a period in which Users trust must be re-earned must ensue. No doubt problems will continue to arise at the Library, however, with the new approach of University Works it is hoped that any feelings of neglect and unjustness on the User's behalf will be assuaged in time.

CONCLUSIONS

Too often the engineering profession takes itself for granted and assumes an arrogant attitude to non-technical people based on a supposedly superior knowledge. Fortunately, most of us get our comeuppance now and again thereby jolting us firmly to earth. We must not only listen to people who depend on us for guidance and advise but we must also hear them. Instead of fobbing individuals off with platitudes we must give them credit for having common sense and we should realize that denying a problem exists is no solution. That is one human lesson to be gleaned from this whole 7 year saga.

From the technical standpoint, University Works has adopted a new policy in dealing with climate control in buildings now and in the future because of the problems experienced in the Library. We no longer construct buildings with inoperable windows. Furthermore all new buildings are designed with constant volume air systems. Air conditioning is not provided except where either scientific equipment requires climate control or occupancy loads cannot be accommodated with ventilation only. It is felt that with properly and finely designed constant volume air systems, the additional energy required over V.A.V. systems can be minimized. In addition, occupancy comfort is not compromised to an unacceptable level and in fact complaints are only registered in very extreme conditions.

Goswami



Lorenz

Mechanical Service Containment Issues in Design of Biohazard Laboratories

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Introduction

Advancements in biotechnology in the medical, health science and other industries over the past decade have challenged process equipment manufacturers and facility designers to keep pace with the industry. This is especially true in the area of containment control as more exotic, fragile and potentially hazardous biological agents are continually being encountered as this new technology evolves. This evolution, combined with an increasing concern for environmental and occupational safety worldwide, has accelerated the demand for safer biohazard containment facilities.

Due to the critical role that mechanical systems play in creating and maintaining a "contained" environment, a thorough understanding of the service requirements for these types of facilities is essential if governmental regulations and industry standards for safety and operation are to be met or exceeded in the years ahead. This paper will identify key mechanical and other facility design issues that must be addressed to meet the various containment classifications and will offer general guidelines for the design of air, waste water, and other support systems that are necessary for safe operation in the biohazard laboratory.

Hazards and Containment Classifications

Biotechnology involves the development and use of organisms for biopharmaceuticals, diagnostic products and for a multitude of applications in medical research. Biologicals that are hazardous to man are termed "biohazardous agents" and must be controlled when they are used in the workplace. The American Industrial Hygiene Association categorizes substances which could be biohazardous (see Table 1) and defines a "biohazardous" agent simply as one that is capable of self-replication.

TABLE 1
Categories of Biohazardous Agents
(American Industrial Hygiene Association, 1984)

A. Bacteria
B. Fungi
C. Animal Viruses
D. Rickettsia
E. Chlamydiae
F. Parasites
F. Recombinant Products
H. Allergens
I. Cultured Animal Cells and Their Contents
J. Infected Clinical Specimens
K. Tissues from Experimental Animals (including dander)
L. Plant Viruses, Bacteria, Fungi
M. Toxins

The degree of physical containment required when working with biohazardous agents is primarily a function of the type of agents handled and their potential harmful effects on humans and other living organisms. The term "primary containment" is used to describe equipment or systems, such as biosafety cabinets, that are specifically designed and intended to protect personnel who work directly with such organisms. "Secondary containment" involves equipment and systems designed to prevent biohazards from escaping through the boundaries of the facility.

Once a need for containment is established, the proper containment level can be accomplished by following sound architectural and engineering practices and by developing proper procedures related to the containment function for operations within the facility. The United States Department of Health and Human Services has published an advisory document in conjunction with the Centers for Disease Control and The National Institutes of Health entitled "Biosafety in Microbiological and Biomedical Laboratories" (CDC/NIH-1988). This document sets general design and operational guidelines for facilities used in working with infectious agents and is generally used as a standard for biohazard facility design throughout North America. Four Biosafety Level (BL) Classifications are established for laboratory and animal holding areas; BL-1 (least hazardous) through BL-4 (most hazardous). Specific criteria are listed for safety equipment, operational practices and facility design for each biosafety containment level. In the United Kingdom, The Advisory Committee on Dangerous Pathogens (ACDP) has established a similar classification system using the terms Containment Level 1 through 4 in lieu of the BL terminology. The ACDP links containment and other design criteria requirements for Level 1 thru 4 facilities with Category 1 thru 4 class agents (as defined by the ACDP). Table 2 summarizes the major minimum design criteria recommendations for both of these guideline documents relative to primary and secondary containment requirements. A review of Table 2 indicates that significant provisions for both primary and secondary containment must be made in Class 3 and 4 facilities. HVAC and other mechanical systems are the primary means to achieve these containment levels. For the purposes of this paper, the term "containment facility" will be applied to Class 3 and 4 level facilities designed to meet the the requirements of either the U.S. or U.K. guidelines.

TABLE 2 - BIOHAZARD LABORATORY CONTAINMENT REQUIREMENTS

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES (U.S.)
ADVISORY COMMITTEE ON DANGEROUS PATHOGENS (U.K.)

REQUIREMENTS	BIOSAFETY CONTAINMENT LEVELS							
	1		2		3		4	
	U.S.	U.K.	U.S.	U.K.	U.S.	U.K.	U.S.	U.K.
PRIMARY CONTAINMENT								
- Safety Equipment Required	No	No	(1)	(1)	Yes	Yes	Yes	Yes
- Class of Cabinet (NSF)	N/A	N/A	I/II	I/II	I/II/III	I/II/III	III(2)	III
- Dedicated Exhaust	N/A	N/A	No	No	No	Yes	No(4)	Yes(4)
- Respiratory Equipment Available	No	No	No	No	(1)	(1)	(1)	Yes
SECONDARY CONTAINMENT								
Isolated Space Required	No	No	No	No	(3)	(3)	Yes	Yes
Space Sealable for Fumigation	No	No	No	No	Yes	Yes	Yes	Yes
Airlock:								
- Airlock Required	No	No	No	No	Yes	(1)	Yes	Yes
- With Decontamination Shower	No	No	No	No	No	No	Yes	Yes
Ventilation:								
- Inward Airflow/Negative Pressure	No	(1)	No	(1)	Yes	Yes	Yes	Yes
- 100% OSA/Exhaust	No	No	No	No	Yes	Yes	Yes	Yes
- Dedicated Air Systems	No	No	No	No	No	(1)	Yes	Yes
- HEPA Supply	No	No	No	No	No	No	Yes	Yes
- HEPA Exhaust	No	No	No	No	No	Yes	Yes	Yes(4)
Dedicated Vacuum System	No	No	No	No	No	No	Yes	Yes
Wastewater Decontamination System	No	No	No	No	No	No	Yes	Yes
Waste Autoclavery	No	No	(5)	(5)	(5)	(5)	In lab	In lab

(1) Optional
(2) Class I or Class II with breathing air suite
(3) Partial isolation required
(4) Two HEPA filters in series required
(5) Autoclave available in building. Preferably in lab for Level 3

Primary Containment

Primary containment is the first line of defense against exposure of personnel and the immediate laboratory environment to infectious agents. There are three major sources of potential infectious microbial aerosol releases:

1. Primary work surface where personnel handle the infectious agents such as tissue culture, necropsy of infected animals, etc.

2. Mechanical manipulative procedures such as centrifuges, blenders, shakers, sonicators, or other equipment or machinery.

3. Activities of infected animals in holding areas and in their transportation.

Primary protection is provided by combining good laboratory practice and technique, with the use of safety equipment. Safety equipment can be broadly divided into two categories:

1. Personal Protective Devices - Equipment intended for direct personal protection such as gloves, gowns, boots, face shields, respirators, breathing air suits, etc.

2. Primary Containment Equipment - Equipment intended to control and remove from the air infectious aerosols created by experimental or production procedures. Such equipment is rated as offering "partial" or "maximum" containment protection. Partial containment equipment may be defined as a containment device that may lose containment due to unsafe operation or accidents. Unsafe operation may include activities that disrupt the directional (inward) airflow, improper placement of materials or equipment within the work chamber, opening or closing doors of isolation chambers, insertion and withdrawal of work, etc. Maximum containment equipment is a device that provides total containment at all times. The "ultimate" protection is usually provided by physical isolation of the work space by means of totally enclosed, gas-tight cabinets.

Table 3 lists the specific primary protection requirements recommended by the CDC/NIH.

Primary Containment Equipment

In general, three types of primary containment equipment are used in the microbiological laboratory and all require specialized air system and other mechanical service considerations based on the level of containment desired. They are:

1) Biosafety cabinets

2) Local containment systems such as special animal cages.

3) Special enclosures for aerosol generating apparatus (such as centrifuges, etc.).

TABLE 3

Primary Protection Requirements (CDC/NIH - 1988)

Biosafety Level	Primary Containment Equipment	Personal/Protective Devices
BL-1	No Requirement	Lab coats/gowns are recommended.
BL-2	Partial Containment Equipment is used for procedures with high potential for creating infectious aerosols and for work with high concentrations or large volumes of infectious agents.	1. Lab coats/gowns and protective gloves are worn. 2. Surgical masks are worn in animal rooms housing non-human primates.
BL-3	1. Partial Containment Equipment used for all manipulations of infectious material.	1. Special laboratory clothing, such as solid front gowns, scrub suit, etc. are worn.
	2. Partial Containment Caging System used to house infected animals.	2. Surgical masks and respirators are worn in all infected animal rooms.
BL-4	1. Maximum Containment Equipment used for all work related to infectious agents.	Special laboratory clothing required such as scrub suit, etc.
	2. Partial Containment Equipment may be used for all work related to the agents.	One-piece, full body, positive pressure suits provided with breathing air systems must be used with partial containment equipment.
	3. Partial Containment Caging Systems used to house infected animals.	One-piece, full body, positive pressure suits provided with breathing air systems must be used .

Biosafety cabinets are by far the most widely used form of primary containment equipment. There are various types and classes of cabinets that provide varying degrees of protection. In the Unites States, the National Sanitary Foundation (NSF) Standard 49 defines the various classes of biosafety cabinets and their intended use. Table 4 lists typical applications for which the various classes of biosafety cabinets should be used. Table 5 lists specific mechanical service features and requirements for use in the design of air systems to support the various type cabinets available.

Special Caging Systems

Some of the largest containment facilities involve the use of animals for testing of microbiological agents in pharmaceutical research. In facilities where "in-vivo" experiments are performed, the infected animals are held in special caging systems which perform the function of primary containment equipment. The holding areas in such laboratories are considered the most hazardous and are usually kept at the highest negative pressure relative to other areas in the facility. It is imperative that the aerosols generated within the cages are properly contained. Caging system manufacturers have developed numerous design concepts aimed at providing the desired containment within the cages and/or racks. To date, all commercial system designs provide only partial containment. Requirements for removal of feces, bedding, etc. and the need to change the cages in a long term study make it very difficult to design a total containment caging system. For commercial use, the major issues that must be addressed when selecting caging systems for biohazard facilities are listed below:

1) Containment level required.

2) Type and size of experimental animals.

3) Degree of cross contamination allowable between the cages.

4) Cage transfer method and frequency.

5) Removal method of contaminated feces/bedding.

6) Method of cage/rack decontamination:

    a. Autoclaving required?
    b. Physical size of autoclave and services required.
    c. Transportation of contaminated cages to the autoclave.

7) Flexibility to change the caging system.

8) Degree of animal handler/researcher contact with animals required.

"Ventilated Cages", "Isolation Cubicles" and "Ventilated Animal Chambers" are a few of the trade names used for commercially available

Table 4 – USES FOR VARIOUS CLASSES OF BIOSAFETY CABINETS

	NSF CLASSIFICATIONS					
		CLASS II				
USE	CLASS I	TYPE A	TYPE B1	TYPE B2	TYPE B3	CLASS III
Low risk biological agents (Level 1 and 2)	No	Yes	Yes	(1)	Yes	(1)
Moderate risk biological agents (Level 2 and 3)	No	(2)	Yes	Yes	(2)	(1)
High risk biological agents (Level 3 and 4)	No	No	(3)	(3)	No	Yes
Chemical carcinogens	No	No	(2)	Yes	No	Yes
Radionucleids	No	No	(2)	Yes	No	Yes
As protective enclosure for aerosol generating equipment	Yes	(1)	(1)	(1)	(1)	Yes

(1) Generally not used due to first cost but can serve this function
(2) Should be used carefully and in low volume work only
(3) Can be used in conjunction with breathing air suite for Level 4 work

TABLE 5 – FEATURES OF VARIOUS CLASSES OF BIOLOGICAL SAFETY CABINETS

	NSF CLASSIFICATIONS					
		CLASS II				
FEATURE	CLASS I	TYPE A	TYPE B1	TYPE B2	TYPE B3	CLASS III
Containment	Partial	Partial	Partial	Partial	Partial	Maximum
Minimum face velocity (FPM)	75	75	100	100	100	N/A
Exhaust air/Recirc. air	100%/NA	30%/70%	70%/30%	100%/NA	30%/70%	100%/NA
HEPA filters in supply	No	Yes	Yes	Yes	Yes	Yes
HEPA filters in exhaust	(2)	Yes	Yes	(2)	Yes	Yes (Double HEPA)
Exhaust arrangement	Direct to outside	Back to lab (1)	Direct to outside	Direct to outside	Direct to outside	Direct to outside
External fan static pressure required (in.wg)	–0.50	N/A	–0.60	–0.75(3)	N/A	–2.50
Relative first cost	Low	Moderate	High	High	Moderate	Very high

(1) These cabinets can be added or removed without affecting the building HVAC systems
(2) Optional. Can also be provided separate from the cabinet
(3) Does not include optional exhaust filters

"partial" containment cages. Some systems have built-in HEPA filters to remove viable particulates from the exhaust air and some require remote HEPA filters or incineration devices in the exhaust air ductwork. Depending on the size and type of caging system, exhaust air may vary from 50 to 200 cfm per rack. External static pressure requirements vary from 0.1 to 0.25 in. wg without the exhaust filtration. Some of the caging systems provide disposable filters at the air intake of the caging system. The pressure drop through these filters must also be considered while selecting the exhaust system. Requirements for support services must be considered on a case by case basis when selecting a specific caging system.

Automatic watering, in general, is not recommended for biohazard facilities to minimize the risk of cross contamination, especially for Level 3 and 4 labs. Also, in-situ washing of the cages/racks, even for large animal cages, is not typically attempted due to the requirement of autoclaving before the cage wash. As a result, trench drains, washing jets and hoses are usually not required.

Secondary Containment

A successful secondary containment design strategy must include an integrated facility design approach; one that considers functional space layouts and adjacencies, proper selection of building materials and interior finishes, flow patterns of people and equipment, and both active and passive mechanical systems and equipment. HVAC and other mechanical systems that are intended to directly prevent or control the migration of biohazardous agents to other non-hazardous areas of the facility or to the outside environment are termed "active" systems. Active systems include ventilation and control systems designed to maintain required space pressurization levels within and around the facility as well as filtration, decontamination and sterilization systems. Other systems that are needed to support operations within the contained environment, but are not used or intended directly for containment control are termed "passive" systems. These include compressed air, vacuum, high purity water, steam, process gases and air conditioning duct distribution systems that often must pass through the containment boundary to support various lab functions and air conditioning systems to maintain desired environmental conditions within the process area.

The coordination and detailing of these passive distribution services is critical if the integrity of the containment boundary is to be maintained. Every penetration is a potential source of concern and special care must be taken to minimize and control their number and location. Cable trays, instrument air tubing and electrical conduits are particularly troublesome and often overlooked when detailing the boundary envelope.

Necessary wall, floor and partition penetrations should be sealed with an inert elastomer sealant. Exposed piping and ductwork should be stainless steel and readily accessible for cleaning and disinfecting. The design should, however, minimize exposed ductwork and piping surfaces which can collect dust and bacteria.

Mechanical service components that require periodic service or calibration such as control valves, humidifiers and terminal air control boxes, should be located outside of the primary containment boundary to minimize interference with laboratory operations and to reduce exposure of maintenance personnel. This generally requires that dedicated mechanical spaces be located directly adjacent to the contained area. It is important to remember that air or piping systems that are open to containment areas become part of the containment boundary until their contents are HEPA filtered or sterilized and all joints should be positively sealed (preferably welded). Provisions must be made to decontaminate supply and exhaust air ductwork. All exhaust air HEPA filters should be bag-in/bag-out type.

Active Systems

One of the most fundamental elements in secondary containment control is the maintenance of differential pressure gradients and in turn, directional airflow patterns, across the boundaries of the facility and within the facility work areas. Pressure gradients of 0.025 - 0.05 in. wg should be established and airflow patterns developed to assure that airflow through the facility always moves from areas of least hazard toward areas of most hazard in both steady state and dynamic conditions. Steady state conditions may be defined as a "static" operational mode when everything is stable. A dynamic condition may be termed as an "upset" condition (minor or major) resulting from a number of routine operations such as movement of people and materials through doors, removal of ventilated cages from the rooms for autoclaving, cage transfer, decommissioning of biosafety cabinets for recertification process or for fumigation, etc. All these operations upset the "static" operational mode and must be addressed in controlling the airflow patterns.

Airlocks are vestibules with electrically or mechanically interlocked entrance and exit doors that prevent loss of space pressure differentials by not allowing doors within containment boundaries to be opened directly to uncontrolled corridors or spaces. Airlocks are required to allow people and equipment to pass through containment boundaries in the operational mode without upsetting relative space differential pressure relationships. Airlocks are generally recommended for Level 3 and 4 laboratories. Transfer air quantities through doors and other boundary penetrations must be considered in HVAC system design. Generally, 4 - 6 cfm per linear foot of door crack is required to maintain desired differential pressure levels across doors in typical Level 3 laboratories. The proper design and physical air balance of the system are critical factors in the system operation. Terminal air volume control boxes are recommended to help maintain constant supply and exhaust air volumes to and from individual spaces within the facility. Air volume control boxes contain integral electronic or pneumatic flow control loops which sense differential pressure across an orifice and controls air volume through the boxes within nominal tolerances by using the flow control loop to regulate an internal damper. Air volumes are thus balanced to maintain desired air transfer quantities and resultant differential pressure relationships between spaces. In general, variable volume systems are not recommended for Level 3 and 4 facilities. Draft-range differential pressure monitoring gauges should be mounted locally to allow monitoring of pressure gradients across containment boundaries by lab personnel. Many of these draft gauges are available with alarm contacts or analog retransmitting devices to allow integration with a remote central facility monitoring and alarm system.

Sometimes, in large scale "in-vivo" experiments, "mass-air" type rooms are utilized. This type of room provides unidirectional airflow patterns within the room and is intended to minimize cross contamination between the animals. This type of system generally employs open type cages that do not provide any form of primary containment. The secondary containment, i.e., the room level containment, is the same as described above.

Decontamination

It is good general practice to "decontaminate" primary containment and in some cases, secondary containment systems at the end of each activity or experiment. Depending on the agents involved and the type of experiments, the decontamination process may involve a simple wipe-down of walls and equipment with disinfectants, steam autoclaving of cages, racks or other equipment, or treating equipment or entire spaces with paraformaldehyde (fumigation). Wipe-down with disinfectants is generally strictly a procedural process and does not typically require special design provisions except for Architectural detailing and finishes. Autoclaving requires special consideration in the selection of autoclaves, type and pressure of steam service and transportation patterns for dirty cages or other equipment to the autoclave facility. Fumigation of primary and secondary containment boundaries and components sometimes poses design challenges that require creative solutions.

For effective and safe fumigation of biosafety cabinets, means should be provided to isolate the exhaust duct from the rest of the system with tight sealing dampers. It is recommended that the positive shut-off dampers for this purpose be supplied by the biosafety cabinet manufacturers and must be specified as an optional feature.

For the cabinets with direct supply such as Class II, Type B2 and Class III cabinets, the supply air side also must be positively sealed. The HVAC design must also consider that room pressurization must be maintained during the process and often temperature, humidity and air change rates must also be maintained during the cabinet decontamination process.

Typically when entire rooms or airlocks are fumigated, the goal is to maintain the paraformaldehyde or other chemical concentrations for specified periods. The design must allow the room air supply and exhaust system to be closed off completely to prevent dilution and the spread of the fumigating gas to other areas of the facility. Doors should be tight seal type and penetrations through walls/ceilings should be kept to a minimum and tightly sealed as discussed previously. Consideration should be given to allow for the remote operation of supply and exhaust air isolation systems during and after fumigation to eliminate the need to enter the area during the decontamination process. Provisions should also be made to protect against accidental closure of the fumigation air dampers during the containment made by use of a key switch or other suitable means.

Waste Water Treatment

Whenever liquid or solid wastes are contaminated, they must be decontaminated prior to disposal regardless of the laboratory containment classification. In addition, in Level 4 facilities, all liquid effluents from showers, laboratory sinks, biological safety cabinets, floor drains, and autoclave chambers must also be decontaminated by heat and/or chemical treatment before release. Central treatment is not required, but often recommended for Level 3 facilities. Special attention must be given to central waste water decontamination systems since hazardous agents can often be concentrated and transportation of wastes through other non-hazardous areas of a facility is often necessary. The following issues should be considered when designing a central liquid effluent decontamination system for a Level 3 or 4 facility:

1. A minimum of two tanks should be used, one for receiving/sampling and one for treatment/discharge. Tanks should be sized for minimum of one day's peak effluent discharge and be constructed of high grade corrosion resistant stainless steel to withstand sterilization temperatures and normal laboratory chemicals.

2. Routing of waste water piping should be as direct as possible to tanks. Piping passing through areas outside the contained areas should be in dedicated shafts or chases and have provisions for leak control and detection by use of double wall piping or spill containment type hanger systems. Piping materials should be selected to match chemical corrosion resistance requirements of normal lab waste water (polypropelene, CPVC, etc.) for all but the autoclave chamber waste water which should be capable of withstanding higher temperatures and should be stainless steel or PVDF. All joints should be welded to reduce the risk of leakage.

3. Treatment systems should be capable of administering steam for heat sterilization and appropriate chemicals for chemical treatment. Provisions should be made to replace tank in future if necessary since even stainless steel will not hold up well to high concentrations of some chemicals, but is the material of choice for the high temperature exposure.

4. Liquid waste decontamination systems are often located on the lower level of facilities and in some cases, special provisions, such as lifting stations or sump pumps, must be included to return tank jacket steam condensate to plant boiler systems and/or to dispose of treated effluent. Chemical treatment for pH control may also re required prior to discharge to municipal or other site systems. The tank area should have provisions for controlling potential tank spills via dike or pit arrangements.

5. Vent lines on drainage piping and air intake lines on autoclave or other vacuum systems serving these areas must contain sterilizable HEPA filters with condensate return directed back to the decontamination tank system.

6. Programmable logic controllers (PLC's) are good choices for control of central systems and should be specified as non-proprietary industrial grade. Local and remote alarm indication is also recommended for system operation and tank level monitoring.

Summary

The information presented in this paper is intended to give you a better understanding of issues related to containment level classifications and general containment control in biohazard laboratories. This information can be helpful in establishing guidelines and criteria for mechanical service and other requirements for future biohazard facility design projects.

A safe and efficient biohazard laboratory is one that is well engineered and well detailed during design and closely monitored and controlled during construction. Issues that impact attainable containment classification levels must be thoroughly addressed early in the design phase of a project and be re-evaluated on a continuous basis throughout the design/development and construction processes. Containment design features should be implemented in a practical fashion as part of the initial construction to avoid retrofit and minimize potential compromises on safety or facility capability in the future.

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Employee Productivity and Departmental Communication

Biting the Training Bullet: Why You Should and How

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The purpose of my presentation is to illustrate why and how to establish a training program at a physical plant department. My comments will be based on our experience at Indiana University's Bloomington campus. First, I would like to give you a little background on our university and campus.

Indiana University was founded in 1820 at Bloomington. The campus moved to its current location in 1884. In addition to the original location, we have seven other campuses, two of which are shared with Purdue University. State-wide our campuses contain about 23 million square feet of space with total full-time enrollment of almost 90,000. The Bloomington enrollment is nearly 36,000. The remainder of my presentation relates only to the Bloomington campus. The Physical Plant at Bloomington has about 750 employees with a budget approaching $35 million. The campus contains about 13 million square feet of which 7.5 million is academic space. Our peak electrical load is approximately 32 megawatts, we use over 200 million KWH of electricity and burn some 85,000 tons of coal each year. We have a typical century old campus and have most of the facility problems that you would anticipate.

Why Train

Successful organizations share some common elements such as a commitment to planning, performance measurement and a system of rewards and incentives. If we look at success stories such as Ford, IBM, WalMart or the Girl Scouts of America, we will usually find an organization with a well defined and understood mission. Organizations like these are committed to measuring how well they are doing in pursuit of their mission. This commitment to managing the mission is a key element for any organization seeking improvement. Regardless of the criteria, review of these companies will reveal an entity devoted to performance improvement, to finding and correcting deficiencies. Training is one means of defining and correcting these deficiencies, particularly in organizations as labor intensive as university physical plants. I believe training is only a part of performance improvement and it does more than just define and correct deficiencies; training plays an essential part in any effort to increase service capability and can provide quick and significant results.

The IUB Approach

From 1978 to 1983, the IUB Physical Plant was reviewed by one group or another almost annually. We were reviewed by the student government, through the internal university review process, and by two different management consultants. Those reviews generally reported an organization perceived as not well organized, with managers and workers of questioned skill and attitudes. Most reviews identified areas beyond the control of physical plant management. For example, they cited inadequate budget, equipment, information systems, communications, increasing unfunded maintenance backlogs (deferred maintenance), and so on. In short we had an adequate supply of problems to tackle in almost any area one would look. To turn our situation around required action on several fronts, one that showed great promise was increased training for all physical plant staff.

Why did we decide to "bite the training bullet?" Why did we believe that training was essential and an important first step to improve our performance? Some of our considerations and beliefs were:

- Improvement would only be possible through change.

- Buildings and academic programs are becoming more complex and almost everyone believes this trend will continue.

- New laws and regulations would make it more and more essential that we train all staff to ensure these requirements were satisfied.

- We expected increasing turnover because critical staff employed in the high growth periods of the 50's and 60's were rapidly approaching retirement age.

- We did not feel we could compete with outside firms for the available employees because our salary scales were generally lower than the competition.

- We saw little reason to believe that public vocational education programs would increase the skill levels of those applying for employment.

- Training would also promote career development, team building and employee participation throughout the management structure.

For these reasons we decided to establish our own training function to increase the knowledge and skills of existing staff and provide training for incoming staff.

Initiating Our Training Program

Once we decided to expand our training we studied the various approaches that others had used. We had a lot of flexibility in determining our training function, as no one employee was the designated training person. We had an apprenticeship program already in place. We had used central personnel's generic training programs, IU School of Business supervisory seminars, and vendors technical sessions. We had never developed our own comprehensive training program. The lack of such a training plan was not beneficial but it did allow us the latitude to do whatever we determined to be the best approach.

After much consideration we made what we believe to be several key decisions. Those decisions were to:

- Establish a Training and Communications Office to coordinate all Physical Plant training programs and develop better communication channels with our staff and customers.

- Hire a full-time Coordinator for Training and Communications -- a person with the education and experience to develop and implement a department wide program.

- Develop training to encompass all employees from top management to entry level clerical and maintenance positions.

- Devote adequate staff, budget and resources to assure success of the program.

We should pay particular attention to the last of these decisions. Too often companies start training programs because it sounds good, it's the current vogue, or competitors are doing it. Then training is continually shorted of funds, people, and equipment. In fact, the training function may become the dumping ground for employees who have displayed minimal initiative or performance.

In other instances the best, most organized employees are asked to take on another function "in recognition" of their excellent past work and proven ability, overloading these employees and forcing them to neglect other duties to spread their energy and time around. Either of these approaches pays lip service to a very critical element in the organization's development and may lead to failure. Most assuredly, these decisions detract from what can be achieved. When we decide to train, we should decide **TO DO IT RIGHT**.

The IUB Training & Communications Office

Our training office was given the responsibility of coordinating all training efforts. We already had an apprenticeship program for the skilled trades, a minimal on-the-job training (OJT) program for utility workers, and a comprehensive custodial training program for our housekeeping division. These programs were fairly successful but depended on the continued interest of people with many other responsibilities and who really did not have a strong background for developing or administering training.

The IUB Training Office must determine the actual training needs. This is done by working with the supervisory staff in each of the divisions and through the input of training committees composed of both workers and supervisors. Once the actual training need is determined it is the duty of Training to find a way to deliver that training. This phase may include contacting other training functions in universities or private industry, contacts with training specialists or vocational schools, or it may involve developing internal programs using resources available in our department or the local community.

Our Training Office is staffed by the Coordinator, one other Training Specialist, one part-time clerical, and occasionally uses work-study personnel. The Training Specialist writes much of our departmental newsletter and does other writing or editing as needed by managers throughout our department. The Coordinator, the Training Specialist and several other members of our staff, from Assistant Directors to first line supervisors, are all involved in classroom instruction.

We initially approached the training budget from a zero base, training competed for scarce resources with all the other critical needs. We decided two years ago to establish a formula based budget to determine the overall level of support. That formula is based on 1.5 percent of the total personnel cost in any of our divisions. Total personnel cost includes fringe benefit costs as well as salaries. Once the training budget amount is established, the division manager works with the Training Coordinator to insure the planned training is focused toward eliminating skill gaps. The actual charges for training include all out-of-pocket costs plus the value of the staff members time spent in training. In two years, no division has used all of their training funds although the investment is increasing as needs are more apparent.

Our Training Office has a wide range of equipment -- computers for word-processing, desktop publishing, database work, etc. They also have VCR cameras and tapedecks for developing training videos or displaying commercial tapes as well as overhead and slide projectors, a training classroom, a limited technical lab for such things as instruction in building controls, back-flow prevention, etc. We estimate our equipment cost thus far at about $30,000 -- a very small amount for the last four years.

We still are refining our training and the amount of training varies among divisions. During the last fiscal year over 200 of our employees (not including the Building Services OJT programs) completed at least one training session. This involved about 6,500 hours of staff time and represented and investment of about $185,000 including out-of-pocket costs and the value of employee time while training. We feel we could double or triple this commitment and still enjoy a reasonable return on our investment in training.

Operating Division Responsibilities

Our Building Services Division (housekeeping) operates mostly independent from the Training Office. This division has an extensive OJT program developed over the past eight years. This division has orientation training for all new employees, a formal classroom program for custodians who want to become group leaders or supervisors, and skill-specific training that is conducted almost daily on techniques, products, and equipment. Our Training Office has spent minimal time with this division due to the nature of custodial training and the need for daily review of routine procedures. With such a strong training commitment within Building Services, they did not require the immediate attention of the Training Office. We have been able to adopt and build upon some of the training concepts developed by our custodial division as we implemented training in our craft, clerical, technical, and supervisory areas.

Each division within Physical Plant is responsible for determining its actual training needs, working in cooperation with the Training Office. This is done first by determining what specific skills are required to do the job and then by assessing the actual knowledge and skills of existing staff. Once this gap analysis is completed, the division management staff works with the Training Coordinator to determine sources for the needed training. The training options are reviewed not only for cost but also for content -- fit with our actual need. Other issues such as time required, scheduling, and actual implementation of the training programs are shared responsibilities of the training office and the operating divisions.

The operating divisions play an active role in making actual training arrangements. If travel is involved the operating divisions generally make those arrangements. The actual enrollment in programs is initiated by the operating divisions although they are subject to approval of both the Training Office and the appropriate member of the Physical Plant Director's immediate staff. We encourage a commitment to training but want to be sure that training requests are consistent with the overall plan and established goals.

The operating divisions are the best source of internal resources. Often there are supervisors with the knowledge and willingness to serve as the trainer. In these cases the Training Coordinator works with the individual to ensure the training sessions are organized, focused, and contain some way to measure the effectiveness of the training. The concept of "Train-the-Trainer" can be most useful in a large organization such as Physical Plant as there is a large body of knowledge out there but many of the people with this knowledge have neither the training or experience needed to train others. Finding a way to use senior personnel returning from off-campus training to spread knowledge is very important to our training program.

Training Format

I debated whether or not to discuss training formats as this is fairly detailed for such a broad session. Our experience tells us this is a very important issue however so I decided to share this experience. In our opinion some basics are:

- Every training session should consider the audience and there must be a behavior goal for the training session.

- While every session may include a lecture portion it is crucial that a hands-on workshop or role-playing exercise be included to promote understanding and practice of the concepts.

- Each training session should include a lesson plan that identifies the goal, the needed supplies and training materials or aids, and a schedule for conducting the session -- classes that become rap sessions or lose sight of the goal will not be successful.

- There needs to be a method of measuring the success of the session. There are several methods: quizzes, practical exercises, case studies, role playing, etc. These assess (for the instructor, the participants, and management) how well each member of the class accomplished the desired outcome.

I'm sure there are a lot of other points that could be made but we feel these few issues are critical in any successful training.

Management's Role

First, management's role must be one of support. At every opportunity top management should reinforce its commitment through both word and deed. Tell the workforce and first-line supervisors the importance placed on training and why. Mention the role of training at McDonalds, IBM, and Ford. Talk about how important training is to the military -- be sure that every staff member realizes that training benefits them and not just the organization. Ask for feedback and input and respond to questions. Bring in appropriate group representatives as early as possible to define needs and discuss strategy and tactics; a program evolving through employee input will enjoy far more support and acceptance. The stance you take and communicate is important. Even more important is the commitment you make to support training with funds and time.

As I said earlier training is desirable because of the results it can deliver -- not just because others are training and it is the popular thing to do. If training is to succeed we must make a real commitment, including money to hire and equip the training staff. We can't just pay lip service to training -- if we're going to do it, we better do it right.

Another role of management is to evaluate the success or performance of our training function. Are skills better? How do we know? Obviously this suggests that training is just one part of the need, another equally important issue being a performance evaluation and appraisal system that enables us to assess improvements resulting from specific training programs. How are trainees doing when they get back on the job? This is hard to measure -- it requires pre-training baseline data and a good way of assessing performance.

What about our customers? Do they think we're doing a better job? How do we measure customer satisfaction? True, customers' perceptions may be subjective. But those impressions are valuable indicators of our performance and the quality of our service. We should also look for ways to achieve a more objective measure of customer satisfaction? This too suggests another critical issue to management that goes hand-in-hand with training -- a strong commitment to customer service and satisfaction; a means of developing a dialogue with customers.

What about employee attitudes? Are grievances rising? What about attendance, United Way contributions, etc.? Do employees feel they are taken for granted or do they feel the commitment to training is a commitment to them? It may be difficult to make objective measurements of these criteria but they are important to the evaluation of our efforts, including training.

Another major responsibility of top management is direction. A lot of us have the title Director -- our jobs are to give direction. I know I spend far too much of my time dealing with the day-to-day issues. Far more important to our success are the long term strategic issues such as planning, performance evaluation, and staff development. Out of such factors flows a character of purpose for our training function and other personnel activities. I believe training is the means of making significant and immediate impact on our jobs and departments. At IUB training will be increasingly emphasized and I'm sure we will enjoy a return on that commitment.

I want to leave you with a quote from Peter Drucker in the April 1988 issue of Inc. magazine.

> "One of the delusions we have in this country is that we can hire educated people. The only industries that function well are the industries that take the responsibility for training... One of the big challenges ahead is not for business to spend more money on training -- it already spends more on training than the school system -- but to do a better job. Right now it's a scattergun approach. Exactly how to change it, I'll leave to the experts. But if you start with the assumption that it's the job of the employer to train -- rather than believe that people come trained -- I think it would be better. We'd have apprentice programs of a different approach. School isn't preparation for work and never was."

Building a Foundation for Excellence

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> "If you are in a ship wreck, you might cling to a floating piano top as a fortuitous life preserver. But this is not to say that the best way to design a life preserver is in the form of a piano top. I think we are clinging to a great many piano tops in accepting yesterday's solutions." Buckminster Fuller

Introduction

This presentation will describe the building of a human resource function within the Smithsonian Institution's Facilities Services Group. Challenges of the 1990's and the associated problems will be identified. The first two phases of an action plan designed to solve those problems will be explained. The results of these actions and new directions for future actions will be mentioned. During the presentation you will be challenged to look at why people tend to cling to yesterday's solutions.

Background

When most people go to the "Mall," they see shops, restaurants, theaters, cars and people. The Mall has an entirely different meaning to the Smithsonian's employees. To us it means the National Mall in downtown Washington, D.C. Many visitors who have never been here before, and thought that the Smithsonian was one museum, are amazed at the size and scope of our operations.

Smithsonian facilities are comprised of over five million square feet of building space located in fourteen museum and gallery buildings in Washington, D.C., and New York City. In addition, the Institution operates and maintains facilities at Suitland, Maryland; in Panama; on the Chesapeake Bay near Edgewater, Maryland; in Cambridge, Massachusetts; and on Mt. Hopkins in Arizona. These facilities range in age from new to 130 years old, and many are listed as National Historic Landmarks.

The Office of Facilities Services directs and coordinates Smithsonian Institution programs and activities relating to facilities planning, design and construction; space management and real property development; physical plant operations, maintenance and improvement; mail services; transportation management; protection services, including physical security and medical services; safety, fire protection and occupational health; and architectural history and historic preservation.

The Facilities Services Group under the Director of Facilities Services includes five component elements: the Office of Plant Services, the Office of Protection Services, the Office of Design and Construction, the Office of Environmental Management and Safety, and the Office of Architectural History and Historic Preservation.

My role is to oversee training and development activities of the Facilities Services Group. My position, however, is located in the Office of Plant Services and I work more closely with them than any of the other organizations.

Organizational Environment

The challenges which face our organization are not unique to the Smithsonian; they are difficulties all facilities services managers face. How do we keep up with buildings and equipment that are deteriorating faster than they can be repaired? How do we manage the backlog of maintenance which grows steadily each year? How do we secure state-of-the-art equipment and the personnel to run that equipment when faced with steadily declining budget allocations? How do we reduce cynicism and improve employee morale? How do we encourage creativity when we are bound by so many regulations?

Moreover, if the Workforce 2000[1] study proves accurate, changes in our employee population will challenge our resources further still. Key challenges which will influence the workplace in the next decade include:

- Illiteracy
- Diversity
- An Aging Work Population
- Rapid and Pervasive Technological Change
- Work Ethics
- Employee Wellness

Established management practices will be ineffective in dealing with these challenges. Management, the function, is appropriate where you need to control the flow of resources - people being one of them - to produce a product. But in a service organization which is built on relationships with customers or other workgroups within our organizations, the outcome is dependent on the exchange of information. You can manage a flow of resources, but not a relationship. Relationships are made of experiences, and feelings, and an exchange of ideas. You can enhance such a relationship, but you can't manage it in the old industrial-age sense of requiring obedience to a hierarchy.[2]

High-performance organizations of the future will be those who see these challenges as opportunities for change and growth.

Developing A Plan Of Action

In 1986, new leadership came to the Facilities Services Group. The new director of the Office of Facilities Services, Mr. Richard Siegle, brought with him a fresh perspective and the belief that the organization can be strengthened by strengthening the individual. As part of his commitment to invest in human resources, he set up a steering committee to research and recommend training and development programs and activities that would enhance the quality of our efforts.

Improving communication, promoting cooperation, and employee development were designated priorities for the committee. The goal was to build morale through creativity, participation, and accountability. Training and development were necessary means to that end.

There have been essentially two phases to the growth of the human resources function. Planning and implementing the foundation was phase one. Building on the foundation was phase two. The efforts in both phases have been guided by the Human Resources Steering Committee. The committee is made up of management- and employee-level participants representing each of the Facilities Services Groups.

Phase One

The Human Resources Steering Committee's first task was to research and recommend training which would focus on enhancement of the individual. Our reputation as a group is dependent on the performance of the individual. Facilities

Services Group employees comprise one fourth of the Smithsonian population and many of them, the museum guards for instance, are highly visible to the public. Let's say you are visiting the Smithsonian from out of town. You ask a guard where a particular exhibit is located. This may be the only Smithsonian employee that you speak with and as a result of that guard's reply, you form an opinion about all Smithsonian employees.

A decision was made to purchase an employee development package. After an extensive review of available courses, The Pacific Institute's Investment In Excellence video educational program was selected. The goal of Investment In Excellence is to help people become even more excellent than they already are. The curriculum fit well with our belief that our people are our most valuable resource.

Between the spring of 1987 and the fall of 1989, five hundred thirty FSG employees completed the initial Investment In Excellence Core Curriculum. The core course consists of two sessions: three consecutive days in the first session, and a one-day follow-up session six weeks later. We provide all materials and classroom time to all employees on a voluntary basis. A companion program, Achieving Excellence In Law Enforcement, is currently being delivered to the six hundred uniformed guards who are employed by the Office Of Protection Services.

What we began teaching through the Investment In Excellence program seemed very different to the employees who viewed training as learning a new skill. As was to be expected, there was and still is some resistance to this "new" approach. (That resistance to change is dealt with directly in the course.) But overall, response to the course has been very positive. Participants notice a change of attitudes in themselves and in others, better communication, and a better understanding of each other.

To give you an idea of what we have been learning, I will highlight two of what I feel are the most valuable concepts. These concepts are built upon the basic assumption that it is our habits, attitudes, beliefs, and expectations which block the use of our full potential.

The first concept explains what happens when we're faced with a problem that needs solving. Creativity depends on seeing possibilities. Instead, many of us are in the 'habit' of looking at our limitations first. People limit themselves by the way that they think; we need to learn to think outside of our limitations.

Now you're probably saying to yourself that it is important to look at the limitations. Simply looking at the possibilities is naive. And you're correct - it's essential to look at both sides. But it is a human and natural process to focus on the limitations and that makes it very difficult to see possibilities.

The second concept explains why it is so difficult to see other options. When we lock on to one way of seeing or doing something - we lock out other options. We cannot consciously focus on more than one thing at a time. To further complicate the matter, we may become emotionally attached to what is familiar. If we've always used our piano top life preserver and we really like it, we will be very limited in our ability to see other options if we need to design a new life preserver. Did you ever wonder why habits are so hard to break?

Which brings me back to how we are using the concepts we are learning in Investment In Excellence. As I mentioned, we are facing many challenges to our established ways of thinking. What we are attempting to do is develop critical thinking skills which will make us more creative and therefore better able to solve our problems from within, especially as we are faced with having to do more with less.

Creative problem solving requires participation and accountability. Participation means everyone must feel free to contribute. Accountability means everyone must have ownership in the goals. Participation and accountability build the self-esteem of the individual. People with high self-esteem create dynamic, high performance organizations.

This "attitude" oriented personal development focus forms a solid philosophical base for our human resource function.

Built on this foundation of personal development is a structure to develop the knowledges and skills of the employee through individual development plans. An individual development plan is the result of a process which identifies needs, targets training to meet those needs, provides for reinforcement or transfer of the learning to the job, and establishes standards to evaluate learning and successful implementation. Needs are prioritized according to three criteria:

- What does the employee need to do his/her job today?
- What will he/she need to do the job in the future?
- What additional development can the organization provide the employee?

A long-term goal we are moving toward is to have Individual Development Plans (IDP'S) for all employees. This will provide the organization with reliable information to budget more accurately for training and development. Another benefit of IDP's is that as first-line supervisors learn to assess and prioritize their own and their subordinates training needs, they learn the thinking skills necessary to become better at developing performance plans.

It is important to note here that training and development programs must be results-oriented to have strategic value to the organization. The result is behavioral change. If there is no measurable behavioral change then time, effort, and money spent on training has been wasted. Either the training didn't match the need or training wasn't the solution. Too many organizations pick and choose training course content randomly and then wonder why there is no coherency in their results.

A needs assessment is an important component of results-oriented training. There are three questions that need to be answered when determining needs.

1. What is the problem and why is it important? Who does what, when, where, why, and how does it affect the organization?

2. What competencies are needed to solve the problems? Identify the ideal behavior or performance standards. Keep in mind that performance or behavior is made up of three competencies:

    a. Knowledges - what does the employee need to know? Recognizing, comparing, correlating, integrating, creating, and storing data and information all represent knowledges.

    b. Skills - what does the employee need to do? Repeating, practicing, habituating are methods or techniques which build skills. Knowledge is the information supporting the skill.

    c. Attitudes - what does the employee need to believe or feel? Forming values, emotional responses, interests, preferences, likes and dislikes that result in behavior are all measures of attitudes.

    When the present performance is compared to the ideal or standard, deficiencies become evident.

3. Will training solve the problem? To answer this question look at the learners: who are they, and what motivation do they have to learn this material? What kind of support from management will they need? Are the benefits of training going to be worth the costs?

Once it is determined that training will solve the problem, a program can be found that matches the learner's needs. Evaluation of results becomes easy using this process. Measurable expectations are identified up front, and the learner is an active participant in the learning.

Many organizations lose their training investment as soon as the learner completes the training. Studies show that eighty-five percent of the total content of a typical training program is forgotten by the end of one year if no transfer strategy is employed. Transfer strategies can be as simple as creating and following through on an action plan to use the new learning back on the job. It is our goal to have an explicit transfer strategy involving management, the trainer, and the trainee for all our training and development programs.

Several other initiatives of the Human Resources Steering Committee have contributed to our foundation for excellence. A reference library was started to support our programs. Employees can sign out books, audio tapes, and videotapes which tie into the programs we develop. Top management from all five organizations meet periodically to share goals, and to learn from each other. An awareness for training and development - or learning climate, is being established.

Planning and implementing this foundation sounds much simpler than it actually has been. At times I have been frustrated by the seemingly slow pace of change and growth in our organization. It's at these times that I'm reminded of a passage from Lao Tzu which was part of an article on Visioning which appeared in Facilities Manager Magazine[3]:

> "Group process evolves naturally. It is self-regulating. Do not interfere. It will work itself out. Efforts to control process usually fail...Learn to trust what is happening..."

Phase Two

While Phase One of our human resource development function concentrated more on foundational values and relationships, Phase Two is taking a more pragmatic approach. What are we doing to implement what we have learned?

An example of this is the Office of Plant Services' New Employee Orientation Program. The goal of this program is to make the employee feel that they matter to the organization. The orientation is tied to the Investment In Excellence program through the rationale that the more comfortable a person is, the better able they are to work to their full potential.

The objectives of the orientation are to show the new employee how and where they fit into the organization, to build their confidence by helping them to feel comfortable, and to establish expectations. Participants actively take part in the orientation through visualization exercises, a knowledge game, and the completion of an action plan for a follow-up discussion with their supervisors about expectations. In this way they become accountable partners in their learning.

Supervisors participate in the new employee orientation program by attending a two-hour session prior to the new employee's arrival. This session is part of the transfer strategy. The supervisor completes an action plan for an expectations discussion they will have with the new employee. The Orientation's evaluation strategy focuses on how the new employee perceives the organization.

At this writing, the orientation is the only completed program to be designed in-house, according to the foundational plan. However, the steering committee has targeted five areas for development in upcoming months. The target areas have been grouped according to priority:

Priority 1

- Strengthening formal team-building efforts.
- Improving communication.

Priority 2

- Improving the knowledges, skills, and attitudes of supervisors and managers.

Priority 3

- Working toward building a more effective performance appraisal system.
- Having more recognition and rewards within, as well as across SI organizations.

We feel confident that as we involve employees in meeting these challenges, creative solutions will emerge.

In addition to the efforts of the Human Resources Steering Committee, five special teams were created this year to solve problems relating to affirmative action and equal opportunity, customer service and delivery, design standards, low voltage wire management, and the exploration of an off-mall consolidation of the Office of Plant Services operations. These special teams meet regularly and include representatives of all the Facilities Services Group and other Smithsonian organizations where appropriate.

Not all learning occurs in the classroom. Many creative activities, which have been motivated by our focus on human resource development, are happening in the workplace. Most of my efforts have been directed toward the Office of Plant Services and the following examples are based on my experiences there.

Recently, all workgroups have been asked to participate in the development of an in-house, computerized services support system. Employees have been challenged to look beyond the limitations - to the possibilities and the benefits of this new system. A task force representing all principal users is being recruited to provide input. The task force will utilize teambuilding skills in the process of developing procedures.

Another project is underway to develop a script and storyboard which can be used to produce videotape demonstrations for training. Video equipment is available through the Audio Visual Services Branch; qualified and talented people exist in our workforce. Rather than spend the money on commercially produced video demonstrations, why not do our own?

The Smithsonian's Office of Personnel Services offers valuable and relatively inexpensive training classes. By designing our own transfer and evaluation strategies to accompany these courses, we increase the value of the training.

We can improve our ability to provide on-the-job training by teaching employees training techniques. In one case, an employee in the Office of Plant Services, with my coaching, developed an entire lesson to tie a concept in the

Investment In Excellence program to an everyday work situation. She benefits from the new skills she has acquired in the process; the organization benefits from her instruction.

It is difficult to measure whether these activities increase productivity or reduce absenteeism and job turnover. Morale has not drastically improved overnight. However, if we compare today's organization to yesterday's, we do see change. Becoming comfortable with change facilitates flexibility, creativity and resiliency - three necessary ingredients for growth.

Summary

With the challenges of maintaining deteriorating buildings and equipment, reduced funding, and significant changes in the workforce impacting our operations in the 1990's, it is becoming more and more evident that our people are our most important resource. That belief is the foundation. There are solutions to our problems and they exist in each one of us. Human beings are infinitely creative individuals and that ingenuity can be enhanced if we develop the right environment. By building self-esteem through an emphasis on participation and accountability, we are creating an environment conducive to meeting our challenges. Upon the foundation we are building an effective and efficient training and development program. The quality materials supporting this structure include needs assessment, results-oriented training, and transfer and evaluation strategies. As we move toward our goals we are proud that our foundation is secure and has been formed with a commitment to excellence.

1. Workforce 2000, Hudson Institute, June 1987, studies the work and the workers for the twenty-first century.

2. Taken from: "Growth: Mapping Its Patterns and Periods," by Patricia Galagan, Training and Development Journal, November 1989

3. The Tao of Leadership: Lao Tzu's Tao Te Ching Adapted for A New Age, by John Heider. From "Visioning: Management Fad of Proven Concept?," Alan Gilburg and Martha Spice, Facilities Manager, Winter 1989

In-House Development of Custodial Supervisors: A Success Story

Gregory D. Fichter
Manager of Building Services
Indiana University, Bloomington

Turnover of management team personnel creates a variety of problems in even the best organization. The director or manager has numerous criteria to consider in selecting replacement management team personnel. Accurately assessing the candidates' leadership skills, knowledge of the operation, and communication abilities is essential. A candidate's level of seniority, personal desire to be a leader, role model, and spokesman for the department are all factors to be considered.

How and where can you consistently find qualified replacements for your management team? In the Building Services Division at Indiana University, the solution came with the development of an in-house management training program.

Over the past five years, this Management Training Program (MTP) has provided our division with the opportunity to prepare more than 50 management team members for our organization.

I. Introduction

Description of the Organization

The Building Services Division of the Physical Plant Department at Indiana University is responsible for the regular cleaning and upkeep of over 6 1/2 million gross square feet. Due to the popularity of the Bloomington area, we are blessed with a large population of people wanting to work for the university. This enables us to be very selective when we hire. The division is comprised of approximately two hundred and fifty (250) custodians, all with the same generic job description. There are also 25 working Group Leaders who act in a variety of roles as needed on a day-to-day basis by the respective Supervisor. These roles include acting as project leader, relief Supervisor, providing routine coverage, etc. These Group Leaders report to a front line of supervision consisting of sixteen (16) professionals. The 16 front line Supervisors report to four (4) Area Coordinators, four to each Coordinator. The Coordinators in turn report directly to the Assistant Manager and Manager. The organization chart is basically an inverted pyramid. Most Supervisors have one Group Leader and 14-18 custodians assigned to their particular building or group of buildings. Each of these teams is held accountable for all activity that occurs in their assigned area.

Our organization has developed over the years into what we feel is a very progressive and effective organization. Typically we pride ourselves in our open lines of communication while using a participative management philosophy. We have numerous feedback systems between all levels of the organization to enhance effectiveness and growth. These systems include "team meetings", with custodians, weekly Supervisors meetings with Coordinators, weekly Coordinator meetings with the Manager and Assistant Manager. The Manager also conducts regular advisory meetings with representatives from the custodians, Group Leaders, and Supervisors. This interaction helps bring to light many "grass root" operational or morale problems that otherwise would not be discussed. In addition to these feedback systems, we provide a solid custodial training and development program with quarterly reviews and goal setting. This is done to improve skills, performance, and morale. We also use quarterly performance appraisals and goal setting for each Group Leader and front line Supervisor. This process has a dramatic effect on clarifying goals, improving performance, and increasing the overall effectiveness of our operation.

In addition, we utilize a variety of recognition programs for all categories of staff members in an effort to recognize outstanding performance and improve the morale of our staff members. Several facets of our "Customer Relations" programs have proven to be quite beneficial to our image and reputation on campus. Each of these systems and programs mentioned above could be the topic of an entire presentation, and each has helped set the stage for perhaps the most important program in our operation, the Management Training Program (MTP).

Life Before the MTP

It is likely most Building Services operations of our size experience similar problems when the time comes to find a qualified replacement for any type of Management Team member. As most large organizations do, we prefer to promote people from within the organization to encourage and reward outstanding performance by our staff members. However, before we had the MTP Development Program, we often found ourselves in a bind. Our Supervisors were professional employees and could not be part of a union; however, they were usually selected from our Group Leader ranks. Our Group Leaders could be union members because of their classification. Thus, our real challenge was to develop a program from which we could consistently select people who would be successful Group Leaders and hopefully go on to be effective Supervisors for us. Before our MTP, we had to face several obstacles each time we needed to select new "Group Leaders". In our division, over 90 percent of our operation is required to work at night. Since most people prefer working on a day shift, we consistently have a turnover problem. Our management team averages approximately 5-7 vacancies annually. So several times a year, we had to leap the following hurdles:

1. Seniority. If the most senior applicant isn't the one we want, how are we going to justify not selecting him?

2. Does the person whom we think may be the best qualified really have the operational knowledge needed to actually teach staff members while on the job?

3. Many times the best performer on the front line does not have the skills to be a "leader" of people. If this outstanding performer doesn't know what effective "leadership" requires and/or the organization doesn't know if this person has the desire or abilities to be successful as a leader in the organization, then a selection may be made that has a small chance of success. When forced to make important decisions without adequate information, the future of any organization is compromised.

What we needed was a program which would accomplish the following goals:

1. Provide a lot of reliable, first hand information about the operational knowledge of each applicant

2. Neutralize the seniority issue and help avoid wasting time on grievances

3. Insure that the applicant knows what leadership and

supervision is all about before they get in over their heads. This is obviously important to both the employee and the organization.

4. Convey our expectations of the Group Leader's role to each participant and see if they have the ambition and perseverance to reach their goals while under the stress normally encountered in leadership roles.

5. Establish a program which would provide a means to keep our operation in an upward trend, always improving little by little.

The MTP started in January of 1985. Minor revisions and changes took place frequently in the first year with major revisions occurring in 1987 and 1989. All of our basic goals mentioned above have been achieved; however, as it turns out, the most important and dramatic benefits of this program were not given much recognition at the inception of the program as they are now. These additional advantages turned out to be the catalyst/vehicle for not only custodians looking for promotion but a dynamic development program for our entire organization as you shall see.

II. MTP - Who Fits?/Who Decides?

To initiate the program, the local union officials were briefed about our plans prior to the posting. Even they seemed to like the format of the MTP. It is difficult for any organization to argue against good employee "training" programs especially when the clear cut guidelines would help decrease the number of grievances. The "Certification Committee" then announced the MTP by posting the following description throughout the organization.

* * *

BUILDING SERVICES DIVISION
PHYSICAL PLANT DEPARTMENT
MANAGEMENT "TRAINEE" PROGRAM

The Management "Trainee" Program has been designed to improve the effectiveness of our operation by providing extensive training for those seeking upward mobility in the Building Services Division. This program consists of over 270 hours of instruction that is applied toward various tasks and procedures, respective to the responsibility of Building Services, over a 12-month period. Not only does this program offer opportunity for motivated employees, but also provides the organization with a very effective staff development tool.

Some features of this program are as follows:

1. The program will be divided into three 4-month segments. Each Trainee will be required to work under a different Coordinator during each of these segments. At the end of the 12-month program, the Management Team and the Trainee will have had numerous opportunities to exchange information about the Trainee's progress in the program. This will allow each of the three Coordinators involved with the MTP Trainee to make an informed evaluation on the quality of the Trainee's leadership abilities and operational knowledge.

2. We will expect each Trainee to give verbal presentations at the end of each 4-month segment on a topic assigned by the "Certification Committee". An overall rating of 90 percent must be achieved on each presentation in order to pass.

3. After the successful completion of each verbal presentation, the Trainee will then be asked by the "Certification Committee" to respond in writing to a job-related question. This section will be scored as well and included in the overall score of the Trainee's workshop.

4. Please note that weekly progress reports for each Trainee will be documented on each respective topic by the Group Leader and the Supervisor. At the end of each 4-week period, there will be a monthly review which will involve the respective Coordinator, Supervisor, and Group Leader. This review will evaluate each Trainee's performance and attendance, and will provide feedback to them on their progress. In addition, each Trainee, at this time, will be expected to provide an assessment of the instruction they received in the previous month and answer a job-related question verbally. A copy of this monthly review will be attached to the weekly evaluations and placed in the Committee's file. A copy will also be given to the Trainee. At the end of each 4-month period, the Trainee will be given an opportunity to give his or her feedback/suggestions on the program to date. At this time, the Area Coordinator will fill out a summary of the Trainee's performance.

5. The choice of topics for presentations has been restricted to three main areas: management philosophy/leadership skills, carpet care, and hard floor care. Comprehensive training in other operational areas is received throughout the program and recorded on the weekly progress reports. Each presentation will be given to the Trainee's immediate Group Leader, Supervisor, Area Coordinator, and at

least two other "Certification Committee" members. This group will be responsible for evaluating each workshop.

****

Once the above information is posted for two weeks, our Coordinators ask the Supervisors to have them check their respective teams to see who is interested in pursuing this program. When the interested parties are identified, the following documents are given to them for review. Please refer to attachment numbers 1 and 2 at this time.

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The "Certification Committee" which consists of the four Coordinators and the Assistant Manager also acts as the governing body over all aspects of the program, announces that they are accepting applications from staff members who might be interested in pursuing the MTP, accepts the applications, and reviews them as they would for any job. All applicants understand that this is a voluntary program and that they will be receiving no pay increase while participating in this 12-month program. The main consideration they are given is that those successfully participating in and completing this MTP will be given first consideration for promotions to Group Leader positions. This feature of the program virtually eliminates the possibility of having to promote an unqualified person because of seniority.

The "Certification Committee" determines which applicants meet the minimum criteria. Those who don't meet our standards do not receive an interview, and they are told why. Those who do are interviewed for the MTP class. The people we have in our leadership positions must be effective communicators with the staff, customers, and Supervisors. They also must be capable of teaching the important aspects of our operation. To help identify this type of person in the interview, we not only evaluate the content of the responses, but also the individual's speaking and writing skills.

After interviews are completed, all applicants who have passed the interview are selected to enter the MTP. Each MTP Trainee will be assigned to a different front line Supervisor for the start of their development program.

III. MTP in Action

The MTP is a 12-month development program divided into three (3) 4-month segments. Each 4-month segment has a major concentration of material that needs to be learned by the Trainee. The major concentrations in sequence are: management style/leadership skills, carpet care, and hard floor care. Each Trainee is assigned to a front-line Supervisor for each 4-month period. It is the Trainee's responsibility to successfully complete all of the assignments as required by the program and by the Supervisor during this time frame.

Throughout the program, the Trainee has an organized training format to follow (see Attachment #3). At the end of each week, the Trainee, Group Leader, and Supervisor sit down and provide each other feedback on how the Trainee has performed during that week (see Attachment #4) and discuss any problem that might have come up. At the end of each month, an evaluation of the Trainee's progress takes place with the same parties plus the Area Coordinator. This monthly evaluation summarizes the progress of the Trainee for the month and once again provides an opportunity for open discussion of problems, questions, or suggestions for the Trainee. Involving the Area Coordinator (who is also a "Certification Committee" member) on a monthly basis helps make sure that each Trainee is being given quality instruction and the results indicated are valid. The value of what is being learned by the Trainee is directly proportional to the quality of teaching that is occurring. This teaching is being done by the front-line Supervisor and assisted by the Group Leader. If this teaching is not reliable, the whole program will falter. By involving the Coordinator regularly, a checks and balances system exists which will continually enhance the program.

This same feedback and evaluation process occurs each month until the end of the fourth month. At that time, there are two significant events. First, the Trainee is expected to make a verbal presentation of approximately 30-45 minutes covering the major topic of that 4-month segment (i.e. carpet care). This presentation is given in front of Supervisors, Coordinators, and the Assistant Manager. Three of these individuals evaluate the workshop presentation and rate it as either passing or not passing. A written evaluation tool listing specific points is used by the "Certification Committee" to evaluate verbal presentations. If the Trainee does not pass, he will be given another opportunity at a later date. An MTP Trainee cannot start another 4-month segment until he or she has successfully current segment. If the Trainee successfully passes a workshop, he or she is then given an evaluation of the 4-month segment by all the respective parties including the Coordinator and the Assistant Manager.

If all members agree, the decision to advance the Trainee is noted on this record and the Trainee is then assigned to a new Supervisor who reports to a different Coordinator. After four more months, the same process occurs. By changing Supervisors and Coordinators at least three times, the "Certification Committee" feels that when it comes time to select a Group Leader they will be able to draw reliable information from a variety of people about the Trainee, and enhance the chances of making the right selection. Another advantage to changing areas every four months is that it forces the Trainee to adapt to new buildings, staff members, and Supervisors. This rotation gives them a broad-based knowledge of the operation and makes them more valuable to the organization.

Once the Trainee successfully completes all three of the 4-month segments, a final review takes place with the Trainee and the "Certification Committee". At this time, the Trainee is certified as having successfully completed the program and is told that when a Group Leader opening occurs that he/she will be the first one considered.

At this point if there is more than one person who has completed the MTP, promotions would be given on a seniority basis within that group. We don't mind selecting by seniority from a cadre of now qualified and proven candidates. Our success rate is at a much higher percentage now than without the MTP. Occasionally, due to turnover, we have to promote someone to a Group Leader position while they are still in the MTP. If such a promotion is given, it is contingent upon that Trainee successfully completing the program.

IV. MTP - Other Positive Aspects

As it turns out, the Management Training Program achieved the desired goals with flying colors in a relatively short period of time. We not only had a program that would put us in a better position to select the most qualified people for Group Leader positions but we also had the "vehicle" we wanted to help develop the entire management team structure, solidify the future of Building Services, and create an environment where our staff members were adapting to changes in the operation effectively and efficiently. With a structured educational program where we required the front-line Supervisors to take responsibility for the success of the MTP Trainee we found that the Group Leader, Supervisor, and Coordinator had to be on the same wave-length on every topic. If not, the Trainees soon made us aware of inconsistencies during the evaluation sessions as well as when they moved from one area to another. If procedures were being taught in drastically different ways, the

Trainees became confused and upset. Trainee feedback put pressure on the "Certification Committee", Supervisors, and Group Leaders to tighten up the operation with an emphasis on consistency across all lines. Since the teachers have to know the material better than the pupils, our consistency has steadily improved.

We have not had to spend additional funds to administer our MTP. The development, monitoring, and implementation has always been done in-house. Obviously, the time spent by our staff members in teaching our MTP people is significant. By our calculations, it costs us approximately $5000 worth of Management Team time to graduate one Trainee from the MTP.

However, when considering the monetary investment associated with the MTP, several positive factors should be noted.

1. The consistency of the operational procedures throughout the organization is significantly better and continually improving.

2. The future of the organization is secure because there is a system in place to effectively replace key management personnel when turnover occurs.

3. We are not only teaching MTP Trainees with this money and time, but more than 45 management team members are developing their knowledge, speaking, and teaching skills as well.

4. By making our "customer relations" program a part of the MTP, the people we serve feel very confident in our abilities. Our reputation of providing excellent service has improved dramatically over the past few years.

Conclusion:

The Building Services Division at Indiana University places a lot of emphasis on staff training, customer relations, and management team development. In order to be successful in these areas, certain factors need to be present. Dedicated and loyal staff members that make our programs work effectively are a must for success. Effective feedback systems that encourage open communication between all parties will help the organization improve and grow on a steady basis. Finally, unwavering support for training and development programs must come from the top. In our case, this support is from the Office of the Director of Physical Plant.

Attachment #1

APPLICATION & GUIDELINES FOR THE "MANAGEMENT TEAM TRAINEE" PROGRAM

Please review the criteria and application for this program. If you feel you qualify and are interested, please complete the application form and submit it to your respective Coordinator by the designated date.

1. As a Trainee, you will be reassigned to the floater position in order to facilitate your training and provide valuable experience in many areas.

2. Your assignments will be made by the respective front-line Supervisor and the Area Coordinator. The assignments as well as shift will change approximately every four months in order to enhance your training and to give you a comprehensive knowledge of the operation.

3. You will be expected to learn how to effectively operate all types of equipment currently in use in the department and any future types of equipment.

4. You will be expected to maintain a reasonable attendance record.

5. You must learn and demonstrate effective leadership skills and the flexibility needed for effective management.

6. You should understand that this is a voluntary program and that no pay increase is involved. Successful participants in the MTP will, however, be the first ones considered for promotions into Group Leader positions.

7. During the training period, you will be required to present task-oriented workshops to various groups in order to develop and demonstrate effective public speaking skills.

8. You will be expected to consistently display a positive and enthusiastic approach to the performance of your assigned duties and the goals and philosophies of the Management Team.

9. You will be expected to learn and be able to teach all the appropriate procedures for carrying out the various aspects of the Custodial II's job description. You will be expected to present workshops on assigned topics as indicated in posting.

10. Upon successful completion of the program, you will be reassigned to a regular Custodial II position and appropriately recognized for your accomplishments.

11. If at any point, the Management Team feels that you are not meeting the expectations of the program or you do not wish to participate further in the program, you will be returned to a regular custodial position and you may not be eligible to participate in the program again for a period of 12 months from that date.

I have read the above guidelines and I understand that by signing this document, I am expressing my interest in participating in this program. I understand and will comply with the guidelines mentioned above and in the program description.

Applicant's Signature__________________________

Supervisor's Signature__________________________

Area Coordinator's
Signature__________________________Date______

Assistant Manager's
Signature__________________________Date______

Attachment #2

CRITERIA FOR MTP SELECTION PROCESS

Having the opportunity to participate in the Management Training Program is a privilege which must be earned by the individual employee. In an effort to insure that this is accomplished fairly the following criteria have been developed. To be considered as a potential candidate for the program the employee should successfully meet the following criteria.

CRITERION #1, Excellent attendance record:

Candidates for the MTP program must at time of application have accumulated at least forty-eight (48) hours of sick time and worked at least six months in Building Services to qualify for the program. This forty-eight hour balance must be maintained throughout the program. *NOTE: Future Group Leader candidates must have an accumulation of at least 80 hours of sick time to qualify for a promotion to an SMON position. This accumulation of 80 hours must also be maintained to remain in the position of Group Leader.

CRITERION #2, Candidates must demonstrate the ability to communicate professionally in both written and verbal formats: Candidates for the MTP program will be required to demonstrate their verbal and written communication skills. This will be accomplished through a verbal and written presentation given during the interview process for acceptance into the program.

CRITERION #3, Work performance record:

Candidates who apply for admission to the MTP will be required to have an excellent performance record. This will include a review of the employee's records for merit awards, and incidents of disciplinary action over the last twelve-month period. Candidates who have received written disciplinary warnings will not be eligible to participate in the program until at least a twelve-month period has passed since the last documented disciplinary action. Note: (Applicants must have, or must obtain by the conclusion of the training program, a high school diploma or GED to be eligible for application for future Group Leader positions.)

CRITERION #4, Cooperation:

Candidates must have the ability to interact and perform well with staff members, customers, and Supervisors. They must also have demonstrated leadership skills, and must be flexible to changes in job assignments and shifts. Each candidate must also have shown a consistent positive and professional attitude toward their job and the Building Services Division.

Attachment #3

SCHEDULE FOR
COMPREHENSIVE TRAINING PROGRAM

Reassignment to Different Area______________________ _______
Area Coordinator Date

_____Week 1..................Orientation of Area
_____Week 2..................Review of Directives/Policies/ Guidelines of Dept./Adm. Duties
_____Week 3..................Review of Directives/Policies/ Guidelines of Dept./Adm. Duties
_____Week 4..................Review of Directives/Policies/ Guidelines of Dept./Adm. Duties

_____Monthly Review IX
_____Week 1..................Attendance/Time Cards/Payroll/ Administrative Duties
_____Week 2..................Attendance/Time Cards/Payroll/ Administrative Duties
_____Week 3..................Counselings/Administrative Duties
_____Week 4..................Other Disciplinary Action/Adm. Duties

_____Monthly Review X
_____Week 1..................Planning/Scheduling/Adm. Duties
_____Week 2..................Planning/Scheduling/Adm. Duties
_____Week 3..................Communication/Listening Skills/ Administrative Duties
_____Week 4..................Communication/Listening Skills/ Administrative Duties

_____Monthly Review XI
_____Week 1..................Complete Needed Requirements/ Administrative Duties
_____Week 2..................Complete Needed Requirements/ Administrative Duties
_____Week 3..................Review of all Administrative Duties/Trial Workshop
_____Week 4..................Workshop - Administrative Skills

_____Monthly Review XII - Area Coordinator Summary - Trainee's Feedback/Suggestions

Attachment #4

MANAGEMENT TRAINEE PROGRAM
WEEKLY PROGRESS & EVALUATION REPORT

TRAINEE ______________________________
BLDG.AREA ____________________ DATE ______ SUPERVISOR ______________

PROJECTS COVERED EXPLANATION EVALUATIONS
NI GD OS

1. ____
2. ____
3. ____
4. ____

WORKSHOP - PRACTICE PROGRESS:

____

____

____

ADMINISTRATIVE PROCEDURES: EVALUATIONS
NI GD OS

1. DAILY REPORT - DATES ____________________
2. CALL-IN PROCEDURE - DATES ____________________
3. EQUIPMENT INSPECTION - DATES ____________________
4. SUPPLY INVENTORY - DATES ____________________
5. ROUTINE INSPECTION - DATES ____________________
6. ORDERING SUPPLIES - DATES ____________________
7. JOB REQUEST - DATES ____________________
8. COMPLAINTS - DATES ____________________
9. W/S TIME SHEET - DATES ____________________
10. WORK ORDERS - DATES ____________________
11. TIME CARDS/BENEFIT RECORDS ____________________

EVALUATION: Please give 1 example in each category displayed by Trainee during this evaluation period.

EVALUATIONS
NI GD OS

INITIATIVE: ____________________
QUALITY OF WORK: ____________________
POSITIVE ATTITUDE: ____________________
____
LEADERSHIP ABILITY: ____________________
EFFECTIVE COMMUNICATION: ____________________
PEOPLE SKILLS: ____________________
ADDITIONAL COMMENTS: ____________________
____

Thirty Ways To Improve Custodial Productivity

Jon H. Fraker
Vice President
Service Engineering Associates, Inc.

Most Custodial Departments can yield a productivity improvement of 10 to 15 percent. Many can return an improvement of over 25 percent! The savings can be taken in cost reduction, or quality improvement, or some combination of these. Of course, it may be necessary to make an up-front investment in order to "cash in" on some of these possibilities.

Here are the biggest opportunities:

1. Assign repetitive work (performed more often than monthly) on an area-complete basis. This work should be assigned to one worker who should perform all routine tasks within the assigned area. The work should be measured to insure a fair assignment and reasonable expectations. This will provide an opportunity to evaluate individual performance and to recognize and reward quality work.

2. Supplement the worker performing the routine work with project teams. The project team should perform infrequent, labor-intensive, and costly major tasks such as stripping & refinishing floors, carpet extraction, window washing, etc. The project team should be well trained and equipped with special equipment not required by other workers.

3. Provide a relief staff to perform the work of absent workers. Insuring that each assignment is performed completely as defined should level out the service to the "customer" and should help maintain the desired level of quality. Eliminating the practice of regularly pulling workers from their assigned area to perform the work of absent workers improves morale among

the workers by allowing them to successfully complete the work assigned to them.

4. Perform the routine and project work at the time of least occupancy, which in most cases is on the evening or night shift. Performing the work at this time allows the service to be performed with less interference, both to the custodians themselves, and to others in the organization. Further, there are less accident-causing situations, such as wet floors, mop sticks projecting from buckets, etc.

5. Perform "policing" and tending activities on the day shift. Policing activities are necessary to maintain the facility in a safe and usable condition between routine cleanings. Policing activities include refilling restroom dispensers, mopping up spillages, removing litter, maintaining walk-off mats, touching up conference rooms, entrances, food service areas, and other public use areas.

6. Provide adequate full-time supervision. The quality and quantity of work derived from the workers is directly related to the quality of supervision provided. There is no substitute for adequate full-time supervision. It is literally the backbone of any department. The supervisor should provide the classroom training, conduct the performance evaluations, and administer discipline for all workers assigned to that area.

7. Use working group leaders, in addition to full-time supervision, to maximize the productivity of the department. The group leader can head a project team, lock and unlock the facility, distribute supplies to janitorial closets, perform minor repairs on equipment, provide on-the-job training, and numerous other activities. The group leader should never be used in lieu of supervision. Group leaders should be selected on the basis of their performance and their desire to serve in the position.

8. Consider the use of selected contracted services to supplement the activities of the department. Window washing, carpet extraction, renovating of wooden gymnasium floors, major moves, construction clean-ups, and high dusting are some examples of activities that might successfully be performed by a private contractor.

9. Use the "delivery" rather than the "pickup" system of supply. Each janitorial closet should be stocked with the supplies necessary to perform the tasks assigned to the worker using that closet. Supplies should be delivered before the workers report for their assigned shift. Using this system will eliminate a major reason for the worker to leave the assigned area, and thus reduce non-productive time.

10. Workers should never be allowed to run out of chemicals and supplies. Permitting this to happen sends a message to

the workers that management does not do a good job of planning and that they cannot be relied upon. Allowing workers to run out of supplies encourages workers to stockpile (hoard) chemicals and supplies, pilfer from other areas, or even bring chemicals from home.

11. Use quality chemical products. Chemical products should be provided that meet minimum written specifications, as well as pass performance tests conducted within the facility. The cost of quality chemicals represents a very small part of janitorial expenditures, but can provide significant labor savings by eliminating the need to redo tasks too frequently.

12. Provide powered equipment of suitable size, type, ruggedness, and quantity. For example, every additional inch in diameter of a floor machine will considerably increase the user's productivity while requiring no additional effort to use.

13. Avoid the need for workers to share equipment. It is best to provide each worker with the equipment necessary to perform all assigned tasks. This would prevent workers searching for equipment being used by someone else, reduce non-productive travel time, and provide accountability for the care and maintenance of the equipment.

14. Provide "put-away" or clean-up time at the end of the work shift. Examples of activities performed during this time are emptying of mop buckets, rinsing out wet mops, emptying trash from the collection cart, wiping down equipment, cleaning the mop sink, and leaving the janitorial closet clean and neat. Typically, fifteen minutes is adequate for performing these activities.

15. Consider part-time personnel to supplement the department labor force. Many situations are conducive to using this system, such as small buildings or portions of buildings located in an isolated part of the campus or facility. Costs for part-time workers is often much less than the travel time required of full-time workers to move to these areas.

16. Provide well-equipped, shelf-type custodial carts whenever possible. The custodial cart permits the worker to move chemicals, tools, and supplies along together, thus eliminating large amounts of non-productive travel time. It should be a good-looking, non-rusting cart with casters that allow easy movement.

17. Be sure each job has been measured. The only alternative to measurement is guesswork, and certainly no work should be done on that basis. Only through work measurement can we properly balance and assign custodial work.

18. Operate a firm absentee program. Be sure that the workers understand the rules and that the rules are to be

enforced. Be especially careful to watch for patterns of absence, such as taking Mondays or Fridays off to extend the size of the weekend.

19. Take soil prevention seriously. It is much easier to maintain facilities when soil is contained near the entrances, rather than when the soil is allowed well inside. Grating and walk-off mats are the main line of defense in soil prevention.

20. Purchase chemicals in one-gallon and/or 5-gallon containers, rather than 55-gallon drums. The large containers cause accidents, spillages, and require a considerable amount of time to transfer the contents into secondary containers.

21. Use a calibrated dispensing device for measurement. It can be fitted directly onto the one-gallon container. It is a convenient and accurate means of measuring chemicals and helps reduce spills involved with using measuring cups.

22. When possible, involve the workers in the selection of products, equipment, chemicals, uniforms, and procedures. People support those activities and decisions in which they have had some input. It will not be possible to involve workers in every decision, but there are many decisions to be made in which the workers may provide valuable insight and information.

23. Provide properly sized and equipped custodial closets. If the custodial closet is inadequate, supplies and equipment cannot be placed in them properly. This requires the worker to spend an inordinate amount of time relocating some contents of the closet in order to reach other contents. Also, many spills occur which can damage contents and provide unsafe working conditions within the closet.

24. Use "vertical" rather than "horizontal" scheduling for some situations. This system permits a team of several people to be working on the top floor of a building on an evening shift (doing area assignments, not working as a team) with the floors below unlit. After completing the work on that floor, the team would then move down to the measured area assignments on the next lower floor. This provides easy location of the workers by the supervisor. It also means that only one floor is lit at a time (in a high-rise building, vertical scheduling would involve groups of floors).

25. Be sure to get involved in "Design for Maintainability". All renovation and construction designs should be reviewed by members of the custodial department before the final drawings are prepared. Recommendations concerning the size and location of custodial closets, the availability of water and electrical outlets, soil prevention devices, the location and colors of carpets, the adequacy of floor drains, and the location of mirrors are just a few of the many factors that affect the amount of labor required to maintain a facility.

26. Eliminate all products containing a "poison" or "flammable" label. There are many products that do not have these characteristics that will do the job.

27. Remove carpet stains using stain-removal kits. Each routine or policing worker assigned to an area containing carpets should be trained and equipped to remove carpet stains. Many times, the succesful removal of carpet stains depends solely on how quickly the worker attempts to remove the stain.

28. Avoid obsolete products such as scouring powder, ammonia, bleach, steel wool, pine oil, etc. Modern materials cost little more, do not harm the user or the surface on which they are used, and do a much better job.

29. Use positive titles such as Environmental Service Worker, rather than negative titles such as Janitor.

30. Let the custodial office be an example for others. Maintain a neat and organized desk, remove unprofessional materials and pictures from the walls, and remove outdated magazines from the office. The custodial office should send a message to everyone that the department is well-organized and efficient.

Time Management

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Good morning! Welcome to this session on Time Management. Did you know that in their lifetime, the average persons spends

- -7 years in the bathroom
- -5 years waiting in lines
- -3 years sitting in meetings
- -2 years playing telephone tag
- -6 months waiting at red lights

Husbands and wives only spend

- -4 minutes in meaningful conversation with each other per day
- -30 seconds in meaningful conversation with their children each day

Frightening statistics, aren't they?

I'd like to begin by asking how many of you have previously attended a session on Time Management. Then it is safe to say that your expectations are to refresh your memory and/or get verification that what you are doing is correct.

Let's begin by talking about expectations. Specifically, your expectations about your time management problems.

Today we'll focus on managing your time and projects. My plan is to discuss how you manage yourself, others, and how to manage projects.

The game rules for today are to RELAX, HAVE FUN, ASK QUESTIONS, and BE YOURSELF.

On the first page of your handout there is a list of 12 items that most of us spend time on each day. Begin by estimating how much time you spend each week on each of these things on the list. What's the total number of hours at everyone's disposal each week? That's the number that goes on the total line at the bottom.

The purpose of this exercise is to identify where your time is going. Most people have 20-30 hours of unscheduled time each week. The fact that we have the same amount of time really is not an issue--the issue is how you use that time. What you do with the discretionary time often makes the difference between success and failure.

Time is the only totally exhaustible resource that we have. Money can be saved for another day or month. But at the end of each day the time that we have not used cannot be saved or regained. Some find it is helpful to identify what gets in the way of your time management. Others prefer to concentrate on ways to improve the use of your time. I'd like to do both.

Using the second page, circle either yes or no in response to each question. Please list at least 2 time wasters at the bottom of that page. Issues and time-wasters that are identified will be discussed.

There are two tools that are vital to good time management.

1. a calendar
2. a "to do" list

CALENDARS

Calendars allow you to control the activities that you plan to perform. Calendars help keep your list of appointments, but should also include important dates, follow-up dates for projects, calls to be made, and calls expected.

"TO DO" LISTS

"To do" lists are action sheets that help you prioritize the "Best Use of Your Time" right now.

DEADLINES

Suggestions for deadlines are:

-ways to use deadlines

-how to divide projects

-plans for follow-up schedules

-uses of waiting time

-learn to say "NO"

PAPERWORK

Learn to use the OHIO rule. Suggestions will be made to reduce the amount of paper retained. Use the system of Respond, Route, Hold (with a date to discard), or Toss.

Statistics on Paperwork

-Americans create 30 billion original documents annually

-Paperwork costs over $100 billion annually

-Sixty-five cents of every dollar spent on recordkeeping is wasted on unnecessary files and duplicate copies

-Seventy-five percent of documents that we retain we never refer to again

-We spend $25,000 to print and process forms in a four-drawer file cabinet of 18,000 pages

-We maintain 18,000 pages for each white-collar employee, and this increases 4,000 pages per year for each employee

-Sixty percent of all clerical work is spent on checking, filing, and retrieving information

MEETINGS

The average manager spends 16-18 hours per week in 5 or 6 meetings. Hints to reduce the number of meetings and the length of meetings:

-use stand-up meetings

-include times on agendas

-don't wait for latecomers

-don't repeat information for late arrivals

INTERRUPTIONS

Identify types of interruptions and approaches to stopping them for:

-visitors/customers

-telephone calls

-employees

-boss

WORK AREA

Ways to organize work sites to cut down on wasted time:

-adequate storage space

-clean work areas

-location of files, furniture

-sufficient work space

PROFESSIONAL ASSISTANTS

How effectively do you use your professional assistant? Ask yourself:

-do you review schedules daily?

-do you interrupt him/her frequently?

-do you let your assistant handle routine activities?

-do you delegate to your assistant?

-do you give positive feedback to him/her?

-do you use a dictation machine? Computer?

-do you frequently switch priorities?

THE 80/20 RULE

Eighty percent of your results come from 20 percent of your efforts. Identify those efforts and concentrate on them.

- concentration is a skill that must be learned
- adjust your schedule to match your energy cycle

DELEGATION

Approaches to determining what and how to delegate. Steps in delegation are:

- prioritize work
- decide WHAT to delegate
- analyze your staff
- delegate the task
- control the delegation

PROCRASTINATION

Focus on the reason for putting off projects and ways to get started. Often perfection gets in the way. Ask yourself:

- if you don't have time to do it right this time, when will you have time to redo it?
- will "effective" work or does it need to be "efficient" this time?
- do you feel out of control?

The following rules for success will help you keep focused:

- establish priorities
- group activities together
- do one thing at a time
- divide projects into "workable steps"
- pool resources
- plan ahead
- always look for shortcuts
- develop tolerance and understanding

SUMMARY

In closing, I'd like to summarize the points we've discussed today:

- -there are tools to make you better time managers
- -try different ways to handle interruptions
- -use delegation techniques whenever possible
- -ask questions to save time and energy
- -reduce the time spent on paperwork/telephone
- -overcome procrastination

Your perceptions and expectations determine your control of your time. Managing your time means managing yourself. Realizing that you can influence things that happen in your life. It means that you can no longer afford the luxury of blaming other people or things when something goes wrong. You will become master of your likes and dislikes as well as master of your time.

I'd like to leave you with a thought for the day:

When you get what you want in your struggle for self,
And the world makes you king for a day,
Just go to the mirror and look at yourself
And see what THAT man has to say.

For it isn't your father or mother or wife,
Who judgment upon you must pass,
The fellow whose verdict counts most in your life
Is the one staring back from the glass.

Some people may think you a straight-shooting chum,
And call you a wonderful guy,
But the man in the glass says you're only a bum
If you can't look him straight in the eye.

You may fool the whole world down the pathway of years,
And get pats on the back as you pass,
But your final reward will be heartaches and tears
If you've cheated the man in the glass.

THE WAY IT IS

Family ______

Job ______

Community ______

Sleeping ______

Eating ______

Commuting ______

Exercising ______

Reading ______

Household chores ______

Personal hygiene ______

Pleasure ______

Yourself ______

Total ______

1. I use daily to do lists Yes No

2. I meet deadlines with time to spare Yes No

3. Occasionally I am late for meetings Yes No

4. Interruptions rule my life Yes No

5. Equipment is located in convenient places Yes No

6. My work area is messy Yes No

7. I use the talents of my professional assistant Yes No

8. Somedays I feel that I accomplish very little Yes No

9. I am good about delegating projects Yes No

My time wasters are ______________________________

____

____

____

Sexual Harassment: Problems and Solutions

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"Sexual harassment is something that always happens somewhere else; it could never happen in the area I am responsible for." This is definitely what each of us would like to think. However, sexual harassment is happening everywhere. The question is, "When will it become so pervasive and intimidating that a claim of sexual harassment results?"

To an extent sexual harassment has been around since Adam and Eve. When the apple was eaten and they were embarrassed by their nudity, old Adam made Eve uncomfortable, and it has continued ever since. Redbook, in 1976, did a survey of 9,000 women and got a response of 90% indicating that they were harassed at work. Feeling that the survey population was not valid, Redbook combined with Harvard Business Review and tried again. This survey polled 7,408 female managers and the result was 63% indicated sexual harassment occurred in their companies.

In another often quoted study the U.S. Merit System Protection Board surveyed 23,000 federal workers in 1981, and 42% of the women and 15% of the men indicated that they were harassed at work. A follow up study was done in 1988, and the results were almost identical. Forty-two percent of the women and 14% of the men indicated that they were harassed.

Some administrators assume that sexual harassment is not a major issue in physical plant because most plant workers are male and there just are not any women to be harassed. True or false? This statement may have had a certain level of truth in the past and still may be true in some plants. However, times change, and even the most traditional physical plant will eventually change with them.

CHANGES IN THE AMERICAN WORKPLACE

The last half of the twentieth century has brought many changes to the American workplace. One of the most significant changes was that of women entering the work force in record numbers. Until about the middle of this century, the woman who worked outside the home was part of a small minority. She had few role models because her mother and sisters probably did not work outside the home. Typically, she was a secretary, nurse, or teacher who planned (and was expected) to leave the work force when she married and began having children. Even the proverbial Rosie the Riveter, who had been so vital to America's wartime success, left the factory when the men returned home. In the last half of the twentieth century, the typical female worker has changed drastically. She is no longer in the minority because well over half of all American females of employment age work outside the home. Marriage and motherhood may cause her to leave a job temporarily, but the typical female worker is a permanent part of the work force whose contributions are significant and long-lasting.

Women Seek New Roles

As women have increased their prevalence and impact in the work force, their roles have expanded greatly. In the 1950's and 60's women were largely clerical or pink collar employees whose roles were important but lacked influence and were narrowly defined. Women "cornered the market" for clerical employees and made few attempts to leave this relatively low paying type of job. Later, women began to branch out into white collar jobs and move up traditionally male professional and corporate ladders during the 1970's and 80's. Not surprisingly, these pioneers found themselves generally unwelcome, and many were forced to struggle against their male coworkers as well as their employers.

During the 1980's and 90's, large numbers of women began entering the last stronghold of masculinity -- the blue collar world. Unlike Rosie the Riveter, these women were determined to stay and gain the financial rewards their white collar counterparts had found in the corporate and professional ranks. In the factories and shops, women encountered even more resistance than they found in board rooms and surgical suites. Pink collar jobs for women had been acceptable because American cultural conditioning led many to believe that they were ideally suited for such jobs. Although many white collar men resented the intrusion of women, their presence was somewhat acceptable because white collar success depends on education, and sex role stereotyping generally classifies women and girls as good students. That same type of stereotypical image tends to work against blue collar women who are automatically perceived as lacking the physical strength and mechanical ability needed for blue collar jobs. Predictably, women in blue collar jobs have not yet achieved the gains seen in the professional and corporate world. American women have made great strides in all areas of the workplace, but the changes have not been quick, nor have they been painless.

Problems and Challenges

Although their job responsibilities may differ, pink, white, and blue collar women all share some common concerns. Most women must cope with balancing domestic responsibilities against the demands of the workplace, and they must also deal with gaining equal access to the positions and salaries enjoyed by their male counterparts. While both of these issues are difficult, a great deal of progress has been made. A third issue, that of sexual harassment, is far more complex and pervasive; therefore, considerably less progress has been seen in this area. Sexual harassment can affect both men and women in all types of jobs; however, no employee is at greater risk for sexual harassment than the woman who holds a blue collar job. Among blue collar women, those who hold the more highly skilled jobs are seen as the greatest social and economic threat to their male coworkers.

"Boys Will Be Boys" Attitude Now Unacceptable

The same cultural conditioning that recognized the female's role in the pink collar world' also adversely affected women in the workplace from a sexual standpoint. The line of reasoning followed is something like this: "Men are men and it is natural for them to make sexual advances toward women. It is just part of nature." Also, if a man approaches a female it is assumed that she led him on. Our cultural conditioning gives a double standard for sexual conduct for men and women. As women have progressed in our society they have asked for and are being granted a more equal role in the workplace. One of the goals that they are seeking is the right to work without receiving sexual intimidation and harassment from their coworkers.

For all employers, addressing sexual harassment is important from legal, ethical, and professional standpoints. However, dealing with this issue is especially important to the physical plant administrator for two reasons. First, the typical physical plant employs a diverse group of people, many of whom are skilled and unskilled blue collar workers. Second, institutions like schools and colleges are expected to take a leadership role in many social issues; therefore, the physical plant may hire women plumbers and electricians long before private businesses are willing to do so. The physical plant administrator will be faced with the responsibility for changing many workers' attitudes and leading other parts of the community forward into the future..

Courts Recognize Two Types of Sexual Harassment

As a nation we recognized sexual harassment officially with the passing of the Civil Rights Act of 1964. It prohibited discrimination based on race, sex, national origin or religion. Early court cases concentrated in the area of race, national origin and religion. During the mid-seventies we began to see a few court cases relating to sexual harassment. Two early cases, Barnes vs. Costle and Bundy vs. Jackson defined sexual harassment in two categories. Barnes vs. Costle defined quid-pro-quo sexual harassment as sexual harassment that causes the loss of tangible job benefits. The EEOC definition is "unwelcome sexual advances or requests for sexual favors, and other verbal or physical conduct of a sexual nature constitute sexual harassment when (1) submission to such conduct is made either explicitly or implicitly a term or condition of an individual's employment, (2) submission to or rejection of such conduct by an individual is used for the basis for employment decisions affecting such individual." A second kind of sexual harassment, "hostile environment" is defined as sexual harassment when "such conduct has the purpose or effect of unreasonably interfering with an individual's work performance or creating an intimidating, hostile or offensive working environment."

These early cases found their framework or basis for opinion in civil rights cases based on race and national origin. The theory was that Congress had the same thing in mind with sex as it did with race, national origin, and religion. Two such cases are Rogers vs. EEOC and Henson vs. City of Dundee. In reference to hostile environment type sexual harassment the Henson court stated "surely, a requirement that a man or woman run a gauntlet of sexual abuse in return for the privilege of being allowed to work and make a living can be as demeaning and disconcerting as the harshest of racial epithets."

Meritor vs. Vinson: A Landmark Case

The first real test of sexual harassment came in 1986 when the U.S. Supreme Court ruled on Meritor Savings Bank, FSB vs. Vinson. The background of this case found Mechelle Vinson going to work for Meritor in 1974. She was hired by Sidney L. Taylor a Vice President and ultimately Vinson's supervisor. She began work as a teller-trainee and was promoted to teller, head teller and assistant branch manager. All participants agreed that the promotions were based on merit. After four years she went on extended sick leave and while on leave filed suit against Meritor and Taylor for sexual harassment. While Vinson was on leave and after she filed suit, Meritor terminated her for excessive use of leave.

Grievance Procedure Not Used

At the trial there was conflicting testimony relating to Taylor's behavior. Vinson claimed that shortly after she came to work, Taylor asked her out for dinner and after dinner suggested sex. She refused but Taylor insisted claiming that "she owed him" because he gave her the job. Vinson gave in. After that time Vinson claimed Taylor had sex with her 40 or 50 times and subjected her to sexual advances both during and after business hours. He fondled her in front of other employees, followed her into the restroom, exposed himself and forcibly raped her several times. Vinson testified that she was afraid of Taylor and did not report his activities to higher authority or use the bank grievance procedure prior to filing suit. Had she used the grievance procedure she would have had to report to Taylor as her supervisor.

Behavior of Complainant as Evidence

Taylor denied the sexual activity. He stated the actions were in retaliation for a business related dispute. Voluminous testimony regarding Vinson's dress and personal fantasies were introduced into evidence. The related inquiry into the employee's dress or personal fantasies resulted in a ruling that such evidence is permissible. Sexual harassment cases are generally one-on-one cases and not allowing the employer to present evidence indicating the advances were not unwelcome would lead to almost inevitable guilt on the part of the employer. The court ruled that the "trier of fact must determine the existence of sexual harassment in light of the record as a whole." Meritor also denied Vinson's allegations and asserted that any sexual harassment by Taylor was unknown by Meritor and was done without its authorization.

Hostile Environment Reaffirmed

The case was tried in the Washington, D.C. District Court, appealed to the D.C. Circuit Court and finally appealed to the U.S. Supreme Court in 1986. The Supreme Court ruled in the case and went a long way toward shaping judicial interpretation in the area of sexual harassment. Essentially the Court upheld the idea of hostile environment sexual harassment. The Court made clear that this must be conduct which affects a "term, condition, or privilege" of employment within the meaning of Title VII. The activity must be "sufficiently severe or pervasive to alter the conditions of employment and create an abusive working environment." (This is slightly different from the EEOC guideline.) The Court also noted that making occasional references or suggestive actions generally would not be sufficient to affect the terms or conditions of employment.

Addressed Issue of Voluntary Submission

In the question of whether Vinson had voluntarily submitted to Taylor's sexual demands the Court ruled the issue was not voluntary or involuntary but welcome or unwelcome. The Supreme court stated that the "correct inquiry is whether respondent by her conduct indicated that the alleged sexual advances were unwelcome, not whether her actual participation in sexual intercourse was voluntary." The Court's ruling on voluntary is based upon the idea that a victim may voluntarily submit to sexual conduct for fear of job related retaliation. In consideration of this theory one should keep in mind the court's definition of a supervisor "the mere existence - or even the appearance - of a significant degree of influence in vital job decisions gives any supervisor the opportunity to impose upon employees. That opportunity is not dependent solely upon the supervisor's authority to make personnel decisions; the ability to direct employees in their work, to evaluate their performances and to recommend personnel actions carries attendant power to coerce, intimidate and harass. For this reason, we think employers must answer for sexual harassment of any subordinate by any supervising superior."

The Supreme Court refused to reach a determination on employer liability relating to sexual harassment by a supervisor. The Court felt that in this case the facts were too unsettled for a determination. This determination will permit in some cases the employer to be held liable even though he did not receive notice from the complainant.

Prevention Is Essential

In light of this case what can we as managers and employers do? The best solution to sexual harassment is prevention. Preventative programs can:

1. reduce chances of occurrence
2. reduce time for employer to find out
3. increase chances of offended party taking self action
4. increase chances for internal resolution and effective intervention
5. increase employer's good faith record if the case goes to litigation
6. increase work force productivity by reducing harassment and its distractions

The corner stone of any preventative program is a strong anti-harassment policy. This policy defines sexual harassment and sexual discrimination and states that neither will be tolerated. The policy should carry an assurance that complaints will be promptly investigated. It should include a grievance procedure that encourages reporting of alleged violations. The policy should be disseminated and should be reviewed.

Writing and Applying the Policy

The policy should also keep the following points in mind: 1) it should be consistent in style with other policies, 2) it should not be "full of sound and fury and signify nothing." If you don't intend to enforce it don't write it, 3) it should not attempt to cover every situation, 4) it must be equally applied to everyone.
In dealing with complaints, confidentiality is of the utmost importance. Regardless of the outcome, the effect on both the complainant and the alleged harasser has considerable liability involved.

In most grievance procedures the complainant reports first to his or her supervisor. This procedure is fine, however, an alternative procedure for reporting problems to a person outside the normal chain of command should be included. This second procedure is absolutely necessary to protect the complainant in the event the supervisor is the harasser. Since most cases involve men harassing women it makes sense to have a woman available somewhere in the procedure. Complaints should be made in writing. This is important for several reasons: 1) it is a test of the complainant's credibility, 2) it pins down the facts, 3) it protects the officer to whom the complaint is made and the employer from liability resulting from an investigation.

Sexual harassment cases are lose-lose-lose situations. Everybody involved loses. Typically, cases are one-on-one situations, and as they develop, each party tends to polarize and move apart. Mediation in most other grievances tends to result in compromise with both sides moving toward a common solution. In sexual harassment cases there is seldom a satisfactory solution. Each party tends to try to support his or her case by drawing in third parties, and everybody ends up a loser.

As mentioned earlier, prevention is the best solution. However, we must recognize that not all cases can be prevented. If we arm ourselves with a good policy and take action when required, we can at least put ourselves in the best position possible if the problem of sexual harassment appears in our physical plants.

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Developing an Active Public Relations Strategy

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University of Alabama

It is a real pleasure to be in Ottawa at this convention. As a member of the audience in many similar functions, I have looked forward to learning something in each session. Since our mind works at such an incredible speed, it is possible to absorb a great deal in a short time. The sessions I have attended have been helpful because I always get a new twist on solving a problem. My intent is to give that little twist in this presentation.

The maxim that offense is the best defense is very applicable to our business. All the criticism flows downhill and the only way to counteract it, is to divert it and eventually stop it before it starts, through the adoption of a set policy and practice of an aggressive public relations campaign. I have found that this does in fact require a definite strategy and effective tactics. From the recipient's point of view we are being friendly and informative, from our point of view we are plugging the leaks in our information system, building the defenses against negative comments and programming the needs of the user.

Building an offensive strategy in public relations is essential to accomplish your mission in the physical plant. The first avenue of approach was presented by Mr. John Heinz at the 1986 APPA annual convention in Boston. Heinz talked about selling the Physical Plant and its refurbishment. His talk was directed to those in the drivers seat financially and politically. This approach is absolutely essential, in my opinion, and it requires, as he pointed out, an accurate assessment of each building, its condition and the costs to maintain it. These figures should be on file and frequently updated. If this has not been done, then I suggest it as the first step. Use of the APPA audit book is of great assistance in this endeavor.

Mr. Heinz says that few reports are read past the first page. If we agree that those reports are not read we must resort to selling our wares verbally, and hoping people will listen. There are two possibilities for selling of the Physical Plant. One, well expressed by Mr. Heinz, is the direct marketing with the end result the increased awareness of the needs and the concomitant increase in funds to protect the facilities. The second is the public relations approach to the end user.

I would like to digress here a moment and point out that all military reports are accompanied by a cover sheet summary, (appropriately named, staff summary sheet). If the basic facts won't fit on that sheet, then you might as well trash the report, so goes the philosophy. The idea is to cram most important info on the summary sheet and get the readers attention. Once you get his/her attention, the report should stand on its own merits. Another hint, eliminate the big words, keep to the meat and use attachments. If lots of detail is desired by the reader, the attachments allow the reader to selectively read sections that interest him/her, without wading through a lengthy report.

This second avenue of approach through public relations and its inherent ability to reach many of the people who actually use the facilities gains support for the Physical Plant from the bottom. I believe that both of these methods are essential to the smooth functioning of the plant and its upkeep. They are mutually exclusive because they confront different aspects of the image projection. On one side you are after heightened awareness and increased funds from the administration and the trustees. On the other hand, you are increasing goodwill and gaining an understanding of the people who occupy the facilities and how they use them.

We provide many services to the users and when these services diminish, they, the users, are quick to point out that you are not doing your job. But isn't this what happens when the operations and maintenance funds are cut? Isn't this what happens when the plant increases in size by several hundred thousand square feet and your work force is not increased?

In the political process, a politician provides things to his constituency so that he will ingratiate him or herself and be re-elected. (I recognize that other concerns enter into this process but essentially it is true.) Our services are provided so that the user is more effective in his or her position. It is this constituent, the user of our services, that we must satisfy. His or her perception of us and our people will make the difference in how happy or unhappy our lives can be.

As the new guy on the block and chief engineer at a large metropolitan hospital, it was painfully clear to me that there had been little effort at effective communications by the engineering staff with both the administration and the nursing staff. It was also painfully clear that many of the complaints I heard were legitimate and that much of the Physical Plant had been neglected. How it got that way is not germane to this article, but how the situation was reversed is important.

The nurses and staff regarded me and my staff as THEM, and the feeling was very uncomfortable. The adversarial relationship that had been allowed to smolder was detrimental to the operation of the hospital. Who paid the price? The customer, who in this case was the patient. That was not fair to the patient, the staff nor the owners. The actions of the staff directly affect the well being of those who pay our salaries. If the doctors did not admit patients to the hospital and the students did not come to our schools, we would be on the bricks looking for a job. Just think about the number of businesses that fold. Some of them fold because of poor customer relations. The product is there but the selling is lacking. Are any of us guilty of not selling our services?

A situation such as this had never occurred to me before and the "how to solve the problem," answers were not readily apparent. Without a firm plan of attack, I simply started visiting all the departments in the hospital. People say talk is cheap so I thought I can't lose. No sales, no excuses and no advice, just looking for attitudes and problems. Since we operated three shifts a day, I made "rounds" morning, afternoon and a few times on mids. For some reason the midnight shift did not have the problems experienced on the other two shifts.

Through these visits, I became acquainted with the staff and gradually determined the major areas of concern. We fixed those concerns. No horns, whistles or parties to show what we had done, we just did it. It was apparent to the user what was happening. What a marvelous change in attitude occurred during that next six months. We, became part of the team, rather than THEM.

A little trust was established during that period of time. You know, trust is easy to destroy but tough to build. Once the trust was there, I would not let anything destroy it. As a result of that trust, we were now able to offer rational reasons as to why something was or was not possible. Just as we are customers of garages, supermarkets, suppliers, or other agencies, don't we know when we are being put off? What makes you think our customers don't know when we put them off? With the trust just mentioned, you will be able to provide honest answers. Answers such as, no, yes, perhaps in 3-6 months, and you will be believed. They may not like the answer but they know that it is accurate.

Let us proceed to a couple of principles that many of us espouse and few practice. The first is very applicable to our business. It is the KISS principle--Or Keep It Short and Simple. This admonition is meant for all who issue instructions. The basis is that when anything is short, it can be remembered. Retention is directly proportional to the length of the instructions. (I promise that this presentation will not be overly long.) That is why you do not give lengthy messages over the phone. What many of us tend to do is resort to bureaucratic methods. When something goes wrong we write a complete "fix." I think many of us have found that complicated procedures often fail under pressure. People just do not remember what is in the procedure. Please recall that we also said people do not read long papers.

Simplicity is important. If it is complicated it tends to be discarded or only given lip service. My example is the VCR. So many of these units have all the bells and whistles that sound so great when you are in the showroom. The sales person whips through all the wonderful things you can do. You can practically record future events. Once the unit is at home, you cannot figure how to operate half of the options. The instructions become some muddled mumbo-jumbo that is unintelligible, so you learn to record and playback. And you vow to never buy anything that wonderful again.

The second principle is know the organizational structure. We called it the chain of command in the military. Perhaps more aptly stated, who approves projects and pays the bills or signs the purchase requisitions. If there is any feeling of discomfort in this area, do a little research.

The word visit aptly describes your goal.

V. Visibility	For you and your staff
I. Interest	In the constituent
S. Satisfaction	For the constituent
I. Information	For you and the user
T. Trust	They in you and you in they

Communication

Public relations is not the glad hand and empty promises that many people associate with it. It is the ability to effectively communicate. Technically, communication is the process of transmitting a mutually understood message by a sender to a receiver. The important element is mutual understanding. As a supervisor, don't assume because assuming can make an ass out of you and me.

The three major goals of communication is to influence, to inform and express feelings. Communications is a subject unto itself and it is not my intent to belabor it. There are really three types of verbal communication between two people. I want you to remember these three types. Monolog, dialog and duologue. The structure is very simple and easy to understand.

I am delivering a monologue to you now. There is visual feedback but I am not asking for verbal feedback. Imagine that a problem has occurred and you are receiving a report. When the report is finished the employee leaves, you were a receptor only. You just received a monologue. Let us progress to the same situation but the problem is more severe and you are again receiving the report and you constantly interrupt the delivery. These interruptions destroy feedback, as it is not being accepted by either parties, a dialog exists. Neither party bothered to listen to what was said by the other person. We hear a lot of dialog at cocktail parties and other social gatherings. Try to recall most of what has been said at the parties,--any luck?

The third type of communication is duologue. I am sure that by now you have broken the code. Each person in this type of communication is allowed to present a case without being interrupted and most importantly each person listens to what the other has to say. The brain thinks at an incredibly fast speed and there is no need to think of an answer before all the facts are presented. We think at about 650 words per minute and talk at 125. That is an excess capacity of 525 words per minute. Wow! So what is the rush to provide and answer or counter argument. How many times have you been in a conversation with another person and he or she is just busting a gut to reply to your thoughts? What if your computer gave you the answer before you asked the whole question?

In proper duologue, outside of the obvious communication that occurred an extremely important bridge was established between the communicators. In the case of a supervisor/employee relationship it says to each other, he/she is listening to me. How important it is to have a person listen. To actually know that once the answer comes back it will have been given full thought. How many times have you said or heard other people say that nobody listens to them. If we think back to conversations with our teenagers, can we really say we listened to them?--even some of the time? I know that I did not listen to what was really said. I frequently jumped to conclusions of my own while they were telling their long tale.

Now let's really think about our communication. Be honest with yourself and answer the following questions: (1) What do I do with my mind when I am in a conversation with someone else? Wander? Think up answers? Go blank? Am I pre-judgmental about what will be said because I may not like the person? Do I judge the merits of what is said and not the person talking? I am not suggesting that listening is easy. The person I make the most mistakes with is my wife--and that is a no no. There is no simple way to listen, it does take practice and concentration.

I do not believe that I have to ask what this has to do with public relations. I think the answer is perhaps painfully clear. If you were a politician, you would have to listen to your constituents and translate what they say into some tangible benefit for them. If you did that the voters would believe that you have their interests at heart. Having their interests at heart is the key. In our business having the interests of our constituents at heart is also the key.

I am not suggesting that we must be politicians but we must have our constituents interests at heart. We do this by simply trying not to determine what we think is good for them; but listen to them and see what they think is good for them. I can recall some of my ideas, and they were less than sterling. I can also recall sitting down with staff members of that hospital and listening to them. They often didn't know what they wanted, but they did know that what they had was not satisfactory. By listening to our constituents we can put forth suggestions and ideas to solve their problem. Even if this is all we do, and nothing more, they will love us because we cared enough to listen and try to help.

There is another area that I believe a good public relations effort is essential and will pay off in big dividends--that is with our staffs. I recognize that this overlaps, to some degree, the leadership area, and rightly so, as it is an aspect of leadership. Keeping the staff informed on what is going on will pay dividends. Holding regular meetings that address safety, health concerns, benefits, future changes, and other interest areas will pay dividends. If you are of the mind that you and your top staff are the only persons who are players in the PR game, think again. When the plumber fixes a leak, the carpenter fixes a door, a painter repairs a wall, and electrician installs a light or the floor layer replaces the tile, your public relations is on the front line.

Are the people that work for you friendly? Are they competent? Do they do exactly what the work order says or are they willing to do a little extra for the customer? Believe me the customer knows when the staff is not happy. So do a variation of the public relations strategy with all your people right down the line.

It takes a lot of effort to deal effectively with people. It takes a lot of mental energy. Many managers care little how someone feels. Well, most of the people who work for somebody else care. They care about what you think of them, they care about what you think of their work and they care about their job. You would be surprised how your constituents care also. They see two big grown up men come into their office to fix a wire on an electric clock. They see two men repair one piece of tile or floor covering. They see it in their city and state work crews. They see example after example of inefficiency and you still think you do not have a public relations problem?

Before Tom Peters came up with the idea of MBWA (managing by wandering around) we, in the Air Force, had a saying that we were wandering around base (WAB). We knew that if you carried a clip board and wandered around you could learn a tremendous amount about any area you wished. (And you would not be accused of goofing off). I also had a couple of commanders that told me they did not want me to spend more than 40% of my time in my office. I only had 325 people working for me on three shifts around the clock. Some of you have more people and more turf, but wandering around, without a definite purpose, is eye-opening.

To me, a successful manager and leader must understand the basic concepts of what motivate people. These motivations are neither highly complex nor too terribly difficult to discover. Most people will freely tell you what motivates them if you ask them. Others require a few questions before they will relate. This motivation relates to the people who work for us and those for whom we work. We cannot operate in a vacuum. Your image is directly dependent on how many people see you and what they think of you. Remember the politician?

There are a lot of theories of management and leadership but one thing is very clear, leadership can be learned. It takes a little longer because of the involvement of many diverse people. There is a combination of management and leadership in virtually every task we undertake. Often the success or failure of the task or project is not measured in the completion itself but in how it was accomplished. It goes back to the sports axiom of not whether you won or lost but how you played the game. I am aware of the fact that many people do not believe in that concept and I respect their opinion. I do know that when I am involved in a highly complex demanding task and I do my best, I am able to say that I gave it my best shot. I may be disappointed but I can sleep. If I cause the project outcome to be less than it could have been, then it really gnaws at me inside.

There are also forces in a manager/leader that only he or she will know. These forces, according to Tannenbaum and Schmidt, Harvard Business Review, 1973; play a key roll in determining which mode of leadership is selected based upon the situation at hand. These are: (1) his/her value system, (2) his/her confidence level in subordinates, (3) his/her own leadership inclinations, (4) his/her feelings of security in an uncertain situation, or, as the "tolerance for ambiguity."

Now take a hard look at the forces we have just mentioned. A persons value system is critical in any interaction with others. Values being defined as trustworthy, loyal, friendly, courteous, kind, honest, etc. and their opposites. Look for an example in your own work force of a person who has high values and one who has very low values. What is your opinion of each person?

A manager's confidence level in his/her subordinates will, to a large extent, determine how confident he/she is in delegating authority and in dealing with constituents. Precious little will get done without the subordinates.

Remembering that leadership ranges all the way from one person making all the decisions, to the point of simply creating the atmosphere where the subordinates make the decisions, try to place yourself somewhere on the line. How do you rate yourself in the manager's scale. What we are is neither right nor wrong, but we should know what type of manager we are.

Last but not least is the tolerance for ambiguity. Given the nature of the facilities business, a reasonably high level of tolerance of ambiguity is virtually necessary. Hard and fast rules for anything you do is almost non-existent and this factor is a key variable in dealing with problems.

Public relations is nothing more than making it a point to frequent the buildings and offices where people work. In your conversations with them, it is essential to understand your subordinates capabilities. You must know intuitively how much you can promise, and know how to tell someone they cannot have what they desire. Above all, the ability to recognize feelings and sentiments is critical to effective communication.

Do not expect mind reading. I heard a story about a secretary, who was normally willing to do deadline assignments, complaining because her boss gave her an important document to type at 11:45 a.m. and told her he had to have it by 1:00 p.m. She complained that if she had an appointment at noon she could not have kept it. The other person, to whom she was speaking reminded her that it was up to her to tell her boss if she had an appointment at 12:00, or that she objected to rush jobs that intruded on her personal time. That way her employer could plan a little also, and possibly give her the assignment earlier. The point is, the boss can't read your mind.

In order to communicate and develop the ability to understand what others are telling you, your powers of listening will be tested. Remember that is part of the challenge. True listening.

When it comes to selling the Physical Plant, you are the driver. I believe that you have to assess the environment, completely understand where your strengths are and then establish some goals (strategy). Once you have them established you can establish an action plan (tactics). Once that plan is implemented, you can take the pulse of the organization and measure the changes in attitude. Don't expect miracles next week if things are a little rough.

Cultivate your constituents, do lots of little things for them. Ask them to give you a list of 5 to 9 items. Tell them you can't do them all but pick out the two easiest and do them. Keep them informed and on your side.

The public relations side of the fence can be fun if you want it to be. It can be extremely rewarding. It really does not require a tremendous effort but it does take persistence. You cannot do it one week and quit the next. Patience and the fruits of your labor will make the people-end of the business easier.

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Facilities Planning and Construction

A Community College Goes Shopping for Space

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Abstract

One of the primary problems encountered in a growing community college is providing adequate space for classrooms and offices. Truckee Meadows Community College located in Reno, Nevada went shopping for space and found it in a shopping mall. Poorly utilized retail space was converted to classrooms and offices in the summer of 1989. Enrollment in classes offered at the mall space is favorable and plans are being made for further expansion.

Old Town Mall which has been struggling to obtain adequate traffic for its tenants offered attractive rates to the Community College in hopes that classes would bring more customers. A similar agreement had been made with the county library about one year previous. The classrooms were designed by TMCC architect David Eckes and were constructed by Old Town Mall under contract with a local construction firm.

I. Introduction

Truckee Meadows Community College is a two-year publicly funded institution located in Reno, Nevada. The college serves over 9000 students from Washoe County and surrounding communities. The college began teaching students in former Air Force buildings located 10 miles north of Reno at the site of the Stead Air Force Base. Truckee Meadows Community College is operated under the guidance of the University of Nevada System Board of Regents. Recognizing the need to have facilities closer to the center of population, the Regents authorized the preparation of a master plan for community college site selection.

The Nevada Community College Master Plan recommended several sites located slightly south of the population centers of Reno and Sparks based on city and county land use planning which called for major land use development in the southern half of the Truckee Meadows region. Land acquisition costs and limited capital development funds precluded the immediate purchase of one of the recommended sites.

Concurrently, efforts were underway by the Desert Research Institute, another institution of the University of Nevada System, to acquire a 467 acre parcel of land from the U.S. Bureau of Land Management under the provisions of the Recreation and Public Purposes Act. DRI based their acquisition of this public land on the creation of a research park for housing R & D companies. Since the land was essentially free from the federal government, the community college planners seized upon the opportunity to locate the college there as well.

The site offered magnificent views of the Reno and Sparks communities located in the Truckee River Valley known locally as the Truckee Meadows, but the hillside property was very steep and was remote from services and infrastructure. The elevation of the site made it more susceptible to ice and snow conditions than the sites recommended in the community college master plan. The site was not as close to the center of population as the other sites in south Reno.

The development of the college proceeded despite the limitations of the site. The first increment of 40,000 square feet was constructed in 1976 and the college moved its operation from the Stead Air Force Base facilities. A second increment was completed in 1980 which added 100,000 square feet. The third phase of the college was completed in 1987 bringing the current total of on campus space to 190,000 square feet.

Recognizing that on campus facilities would always lag behind the student demand for classes, the college administration aggressively pursued off campus space alternatives. A positive long term relationship with the Washoe County School District dated back to the early years of the college's origins as the School District Adult Education Program. Many of the early TMCC administrators had formerly been employed with the Adult Ed Program. This relationship has translated into three local high schools being used as major night school locations for the college. Numerous other schools in the district are used by the college's Community Services Division for special interest classes. This source of off campus space has been so successful that the number of night classes offered in School District facilities is almost the same as that offered on campus.

Over 50 different locations in the Truckee Meadows area are used for off campus classes. Locations range from a private martial arts academy to the local hospitals. Classes in fire science are offered in fire stations and television production classes are offered at the TV stations. The county library system has offered their community rooms for the Community Services lecture series. The library had similar problems obtaining space for branch libraries and has pursued retail space in the North Valleys suburban area and at Old Town Mall which opened the door for the college to pursue this space alternative.

TMCC has been innovative in fully utilizing the available space, both on and off campus. Special purpose rooms have become multi-purpose to provide space when needed. An art room was shared by a dance class after installing a special vinyl floor, mirrors, and bars on the walls. Computer rooms have become classrooms with the addition of student desks. These actions have not been without controversy and conflicts between the users. Space utilization reports have shown TMCC's use of space to exceed 90 percent effectiveness for classrooms and 80 percent for laboratories. The demand for space was very justifiable considering these statistics.

II. Criteria for Acceptable Off Campus Space

The primary criteria for acceptable off campus space were the same as those in any real estate transaction: location, location, location. The criteria that were used informally in administrative decision making were as follows:

A. Relation to Population Distribution
B. Visibility and Accessibility
C. Atmosphere
D. Availability of Services
E. Adjacent Space Compatibility
F. Possibility for Expansion

Old Town Mall scored highly on all these criteria. The south Reno location of the Mall was across the street from one of the sites originally recommended in the community college master plan. This was an area of town that the college did not have a major night school location through the school district.

Old Town Mall is highly visible because of its advertising for the retail tenants and its location in relation to major traffic arterials. The name and location are widely known throughout the region. Adequate parking is available and access is easy both by car and bus. Despite the second floor location of the available space, handicapped access is good because of ramps and elevators. The actual space available could have posed some problems for the handicapped because of different floor levels but physical solutions were available through the purchase of a wheelchair lift unit. The interior and exterior finishes of the mall give an atmosphere of quality to the facility. Tile floors, planter beds, clerestory windows, skylights, escalators, oak and brass rails and trim work all added to the quality atmosphere.

A variety of services were available in the mall not the least of which was the Sierra View Branch of the Washoe County Library. A cooperative venture between the college library and the county library was established to serve the unique needs of students at Old Town Mall. For example, the county library housed their genealogical collection at the Sierra View Branch so genealogical classes were moved to Old Town Mall to take advantage of this facility. Food services were available in several mall retail outlets. The Raley's Supermarket/Drug store offered school supplies at the west end of the mall. These services were not as extensive as those offered on the main campus but they were certainly more than was offered at the night school/high school locations. Adjacent spaces were occupied by compatible functions. Noise was not a problem and there were no hazardous activities nearby. The compatibility of the library and the community college was a strong positive point. The mall was willing to give the college first right of refusal to lease additional space if it became available.

III. Design of Classrooms and Offices

An educational center at Old Town Mall was an attractive alternative for alleviating the space crisis. The mall management had made an attractive preliminary offer of $0.35 per square foot per month for the first two years providing that the college would pay the leasehold improvement costs. However, an architectural design was needed to determine if the available space would be feasible for use as classrooms and offices.

TMCC had recently hired architect, David J. Eckes, to work on the Plant and Facilities staff to manage all facilities contracts and lighten the load on the director who had assumed additional duties as Acting Director of Computing Services. It proved fortunate that the services of an experienced architect were available on staff since negotiations might have broken down without the preliminary design and cost estimates for the leasehold improvements. There was certainly an element of risk in designing the project first, but without a complete understanding of the architectural feasibility of the project, the college's lease negotiators would have been at a distinct disadvantage. The persons who were confronted with making these decisions and carrying this project through from conception to reality were Paula Ringkob, Dean of College Services (principal business officer) and Bill Bonaudi, Dean of Arts and Sciences. The rally cry at the time was: "The only thing we have to lose is Dave's time!". The decision was made to venture some staff time in a gamble for some very attractive space.

IV. Negotiating the Lease Agreement

Washoe County Library had established a model for the college to follow with the lease that they had previously negotiated with the Old Town Mall management. The Mall had difficulty keeping its second floor spaces leased and was willing to provide an incentive lease rate to the library to receive the additional traffic associated with that public facility. The community college offered similar attractive features to the Mall, a stable long term tenant who would bring additional patrons into the other retail tenants. The leasing plan proposed to the college in April 1989 was as follows:

PREMISES: Approximately 10,160 square feet and located on the second level inside Old Town Mall.

MINIMUM RENT:	Year	Rate per Sq. Ft.	Rent per Mo.
	1 & 2	$ .35	$ 3,556.00
	3 & 4	.95	9,652.00
	5	1.00	10,160.00
	6	1.05	10.668.00

Minimum rent included the tenant's pro rata costs, utilities, taxes, and insurance. These were very competitive rates considering costs in the Reno area and the quality of the space offered. A rental contract was prepared and verbal agreement was reached but a series of delays were generated by bankruptcy, receivership and changes in mall ownership. In the meantime, the college had proceeded with complete construction documents and a negotiated bid arrangement through the Mall's construction contractor. The construction cost had been agreed upon at $195,000. The college had negotiated a construction disbursement agreement wherein the college would transfer the full amount of the construction costs into an interest bearing escrow account. Progress payments would be disbursed to the contractor from that account with a 10 percent retainage kept as a warranty bond. The contractor established his construction period at 60 days. The college had advertised classes to be held at Old Town Mall beginning September 5, 1989 in the Fall Schedule. Further delays in obtaining a signed agreement could have jeopardized the planned fall opening by providing inadequate time for construction. The lease agreement was finally signed by all parties in June which barely gave the contractor his required 60 days.

V. Maintenance and Custodial Arrangements

The University of Nevada System has instituted a formula based budget for operation and maintenance of plant. The college is funded on a biennial cycle based on information provided to the Chancellor's Office a year before the Legislature actually meets. The formulas have not been structured to provide operation and maintenance monies for non-owned space. This has created a dilemma for the college in budgeting for these expenses throughout the current biennium. The college has been forced to find money within its existing resources to meet these expenses.

For maintenance, this has meant that existing staff have absorbed the increased need for services. College labor was used to install cylinders on all door locks within the complex. Our heating and air conditioning technician will be required to maintain these off site HVAC units. The complete range of physical plant maintenance services will be offered to this facility with no increase in staff for operating budgets until July 1991. Custodial services are being provided by a contractor with a budget augmentation from the college's contingency funds. Realistic budgets for these expenses will be sought from the Legislature for the last four years of the contract and any subsequent lease extensions.

VI. Conclusion and Prospects

Despite the budget strains that this project has placed on the college, the concept has been universally accepted and praised as a low cost alternative for providing classroom and office space in an attractive location. Some initial objections were received from Mall tenants concerned with diluting the retail purity of the Mall with public facilities. Those concerns have abated with the beginning of classes in the fall. The Mall management and the college have agreed that it is a "win-win situation" for all parties.

The new classrooms in the Mall location have been well received by faculty and students alike. The reduced commuting distance and pleasant atmosphere have been attractive to students and faculty. Some of our faculty have expressed an interest in teaching their full class load at the Old Town Mall Education Center. The National Guard recruiter next door is advertising the tuition benefits available to TMCC students. The library has noticed a positive impact on their patronage.

The college and the mall are currently negotiating for the lease of a small area to be used as offices for our Veteran's Upward Bound Program. Another adjacent space occupied by the Boy Scouts retail store and offices may become available in the near future. Limited budgets will present an obstacle, but the need continues.

The bottom line is that undesirable retail space has become top quality classrooms and offices in a location that the college has been trying to obtain since its inception.

Inquiries about this unique approach to providing educational space should be directed to any of the following:

Paula Ringkob
Dean of College Services
(702) 673-7034

Bill Bonaudi
Dean of Arts & Sciences
(702) 673-7185

Nick Cimino
Director of Plant and Facilities
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Ault

Kreidich

Construction Management: The Owner's Perspective

Douglas K. Ault, P.E.
Director, Project Management
John Kreidich, R.A.
Design and Construction Project Manager
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Defining Construction Management

One of the first problems in any discussion of Construction Management is to define what it is we are talking about. The term has been widely used in the past 10 to 15 years to describe a variety of contractual arrangements for obtaining construction or construction-related services. In some cases it has been misused as an advertising tool for soliciting business. Construction Management, or CM, as a concept is very simple as evidenced by the following definition offered by the Turner Corporation, one of the nation's largest CMs:

> *"Construction Management is a technique which treats the planning, design, and construction phases of building as integrated tasks, as opposed to separate and linear functions. These integrated tasks are assigned to a construction team comprised of the Owner, CM, and the Architect. Ideally, members of the construction team work together from the inception of the project until completion, with the common objective of best serving the owner's interest."*

Two key elements of the CM concept are evident in this simple definition. First, it is an integrated rather than a sequential approach. This means, for example, that design does not have to be complete before construction starts. This is an obvious time saver, and for this reason, Construction Management is often referred to as "fast-track" construction. This is indeed one of the major benefits of CM, as will be discussed in more length later, but CM is not the only "fast-track" method and the two terms should not be confused; they are not synonymous and not all CM jobs are fast-tracked.

The second key point in the definition is the team approach and the common objective. These statements highlight the other major difference about CM: it is a professional team that is selected by the owner based on technical capability, not cost. This results in an atmosphere of mutual support to meet mutual goals, not the adversarial role that often arises in standard design and bid work.

There is a wide range of services offered by CMs including: constructability reviews, Value Engineering, cost estimating, scheduling, and inspection. The owner may pick and choose services based on the specific requirements of the job. This flexibility of service is important for owners to remember so that they are not talked into buying more than they need under the guise of "full-service" CM. Some people use other modifiers such as "pure" CM or CM/GC to describe different contractual or service arrangements. The important thing to remember is that there is no strict definition of what constitutes CM. CM is simply an integrated team approach for meeting the owner's goals of acquiring quality facilities in a timely and cost effective manner.

History of Construction Management

Having agreed on a very broad general definition of Construction Management, we now turn to a brief discussion of the evolution of the Construction Management process.

Many who are unfamiliar with the process do not understand the reasons for its current popularity. Construction Management as we know it today really came into being in the late 60s and early 70s. A major influence behind the development of this process was the rapid inflation that made it very difficult for project owners to be able to keep projects within budget through the extended time period required for design and construction. During this time, the cost of money became a major concern to owners who were planning large projects. Another development which spurred the Construction Management process was that buildings themselves became more complex requiring more and more specialty contractors and subcontractors. I also have to say that, in my opinion, one of the reasons for the popularity of Construction Management has been the overall trend for architects to take less and less responsibility for projects based on concerns about liabilities and the increasing cost of insurance. I think many owners feel that Construction Management offers them a way to make someone responsible for the project.

Construction Management enjoyed an initial boom period when it was a new concept, and many owners embraced it as an answer to all their problems. Unfortunately, as with many new concepts, some of the people who got into the Construction Management business in the early phases were really not Construction Managers, but they used the Construction Management jargon as a way to drum up more business. As a result, there was a period in the late 70s where the popularity of Construction Management actually fell off. In the 80s, things seem to have leveled off fairly well, and we now see in the private sector a slow but steady trend, especially for large projects, to go to a Construction Management type of arrangement rather than the more traditional design and bid.

In colleges and universities, as in all government or quasi-public institutions, the move toward Construction Management has been much slower. This is primarily due to the perception that Construction Management, as a negotiated contract procedure, is not in keeping with the preference for public bidding. Private institutions have embraced the concept to a greater extent than public institutions, but we find now that even public institutions are utilizing Construction Management more and more. There are ways to structure a Construction Management agreement so that you can still bid the actual contract packages and thereby meet legal constraints which require bidding of state-funded work.

In summary, whenever I talk to people about the use of Construction Management at Penn State, I say that it will probably never be the primary method of construction for the University. That will probably always remain the more traditional design and bid approach, but I think we will see Construction Management used more and more on selected projects, and I think that the same will hold true for other colleges and universities as well. In the following section, we will describe some of the situations in which Construction Management might be considered.

When Should You Consider Using Construction Management?

There are four major reasons why I would consider using Construction Management on a particular project.

The most common reason for using CM would be concerns relating to schedule. As pointed out earlier in the discussion, because Construction Management is an integrated rather than a sequential approach, it offers you the opportunity to fast-track the design and construction much more so than the traditional design/build. For this reason, we consider Construction Management on those projects when we know we must have a facility completed at a specific date and we do not feel we have enough time for a traditional design/bid/build approach.

The second most common reason for us to consider Construction Management is when we have a project where there are cost concerns. By this I do not mean to imply that Construction Management will necessarily bring a project in any cheaper, but Construction Management will enable us to have a higher degree of certainty about the cost of the project throughout the design process. Thus, we would consider Construction Management on a project where we had a very tight budget and a very large program or scope to fit within that budget. The Guaranteed Maximum Price offered by many CMs also enables an owner to fix the price earlier in the process. The professional services of a Construction Manager during the design process also allow the owner to take advantage of his knowledge and expertise to look at Value Engineering proposals, which can help you keep the cost of the project within the budget without having to sacrifice program.

The third concern that would lead us to consider Construction Management would be quality or the complexity of a project. Small projects or projects that are very straightforward in terms of the technological nature of the building would normally not be considered for Construction Management. But if we have a large, "high-tech" type of facility, we feel that Construction Management can give us better quality because it enables us to package the project in such a way to get the best possible combination of contractors and subcontractors in terms of specific specialties that are needed to complete a more complex project. You can also be somewhat more selective with Construction Management in that the overall responsibility for the project rests with a professional that you select based on technical experience rather than the low bid.

The last concern that might cause us to consider Construction Management on a particular project would be staffing concerns. Ideally, I would like to be able to fully staff all projects with my own in-house project managers, contract administrators, and quality control personnel. The facts of life are that I do not always have enough staff to cover the highs and lows of the construction workload for the University. One way to compensate for this is to consider hiring a Construction Manager to provide the type of expertise that you would normally provide through your in-house staff. At Penn State, I am responsible not only for construction at the University Park Campus but for construction at 22 Commonwealth Campuses throughout the state of Pennsylvania, and it is often very difficult for me to provide staffing, especially field inspectors, for some of these projects located a distance away from the University Park Campus. We have found that the use of a local Construction Management firm for some of these projects at the more remote campuses can really be a benefit in terms of giving the owner more on-site representation.

Primary Benefits of Construction Management

Some of the benefits of Construction Management have already been alluded to in the previous section. We will look at those in more detail in this section. Some of the benefits of CM accrue primarily during the design or pre-construction phase while others occur primarily during construction. We will look at each phase separately and then discuss one basic benefit which is available anytime during the life of a project.

There are two primary benefits in using CM during the design or pre-construction phase and they are: better design reviews and more accurate project budgets. Design review is a very complex and intense process. One of the simple advantages of using a CM is that you get another set of professional eyes to look at the project while it is still on paper and problems can be more easily corrected. The CM offers an unbiased view because his ego is not tied up in the design. The CM also brings a different perspective because of his experience in construction; he will be looking for things which may cause problems in construction. This "constructability review" is very helpful in avoiding costly change orders during construction; in fact, the CM may often make suggestions for changes which may save money. This is known as Value Engineering. Because a CM has a construction background, he usually can provide a much more realistic cost estimate during design. Architects are notorious for being poor estimators, and that is not surprising given the fact that most of them do not have the background or necessary data to produce reliable estimates. Many CMs are so confident of their ability to estimate a job correctly that they will offer to fix the price of a project before it is even bid. This is called the Guaranteed Maximum Price and is another option which is available to the owner.

The primary benefits of CM during construction are better control of schedule, cost, and quality which, of course, are the three essential elements in any project. The CM can control these essential elements because the contractors are responsible to the CM for their performance. This is true whether each contractor is a "prime" or if they are all "subs" to the CM. The second approach merely gives the CM the added clout of directly controlling the purse strings. The CM controls the schedule by coordinating the activities of all contractors, subs, suppliers, etc., to make sure that the job flows smoothly without interruption or conflict. This is done by carefully monitoring the Critical Path schedule and making sure that essential activities have priority. Because of their special relationship with the owner, they can even pre-order long lead time items or break out critical elements of the work for early start. Quality is controlled through careful review of submittals, on-site inspections, etc. Because the CM is thoroughly familiar with the design, he is aware of those areas where problems may arise. The years of construction experience are a big plus as well. Cost control occurs through careful monitoring of contractor's bids and payments and through quick and careful resolution of any problems in the actual work. Additionally, if schedule and quality are properly controlled, then material and labor costs will stay in line. As the old saying goes, if you can control time, cost, and quality, you will have a successful project.

One of the questions often asked by my administration is, "Why don't we just do CM for ourselves?" This is a good question and one which merits some discussion. We do try to follow many of the practices used by Construction Managers, but we do not have enough staff to provide the kind of close coordination and control you get from a CM on every job. This is why the flexibility offered by CM is one of its biggest benefits for Penn State. We can use a Construction Manager to augment our staff where and when help is needed. Perhaps we only need help during the design phase, so we hire a CM to do constructability reviews and Value Engineering. Perhaps we only need help during construction, so we hire a CM to monitor the schedule and provide on-site inspection. CM is a flexible tool which we can use to augment our own in-house capabilities. There is a trade-off which must be recognized in the use of any outside consultant. We as an owner may lose some measure of direct control when we use CM and some may not be comfortable with that until they have tried it a few times. The loss of control may also impact on standard administrative procedures. For example, if we hire a CM to fast-track a job, we may not have all the details we need for Board of Trustees review at certain stages. This, too, is a problem which has to be worked out through experience. CM is not right, nor is it required, for every job, but it does give us a way to provide better control on selected jobs and to fill in for inadequacies in our own capabilities.

What Does It Cost?

The question most often asked about CM is, "What will it cost me?" Many marketing people, in an effort to generate business, have made exotic claims about the cost savings available through Construction Management. **It must be clearly understood that Construction Management should not be used primarily to save money.** That may be a secondary effect through Value Engineering during design or through better coordination during construction but this is incidental. Just as CMs are chosen on a technical basis, the jobs where CM is to be used should be chosen for technical reasons.

On the other hand, many of the detractors of CM claim that it is more expensive than traditional methods. This should not be the case either. One argument that is often made is that you pay for services twice by having a CM and an architect on the same job. If the professional agreements are correctly written and clearly understood by all parties at the outset, this is not a problem. When a CM is used, costs are broken out differently in the construction budget, and it often appears that CM is costing a lot of money. Although CM costs are often more visible and may have to be paid "up front," the typical fees for CM are about the same as the profit and overhead paid to a general contractor. Also, you must consider the hidden costs: someone has to coordinate the job. If you don't pay the CM to do it, you will pay through higher administrative costs or, worse yet, through change orders and time extensions. The bottom line is that there is no bottom line: cost should not be a consideration at all in the decision to use Construction Management for a particular job.

Case Studies

At Penn State we have found Construction Management to be a powerful tool for managing difficult projects. This section of our presentation will deal with specific processes we used in implementing Construction Management at the Penn State Milton S. Hershey Medical Center. In this section we will share our experiences in working with Construction Management on two different projects. Finally, we will look at a third project where we considered using Construction Management but ultimately chose to bid it out as one general contract.

The Construction Management form of building delivery is founded on the idea that a team working together can be more effective than the same parties working individually. In Construction Management, the owner, architect, and contractor form a team. As in any team effort, the best results are realized when all members are skilled in their respective roles and hold compatible values and styles of working. The selection of the right partners for the team is critical to the project's success. As the owner, you are looking for a Construction Manager skilled and experienced in managing your particular project, one who fits into your own management style. We are going to show you a process we used to select a Construction Manager for the Hospital East Addition of the Milton S. Hershey Medical Center.

Establishing Roles and Scope

The process begins with defining the who, what, and when of the project. Who from the institution will participate in the process? What will be the scope of the project? What is the required scope of Construction Management services? When will the project start? When is it to be completed?

Clarify the roles of the participants early. An ambiguous chain of command can result in false starts and wasted effort. This may prove easier said than done because many who should be involved early in the process may not understand the impact of Construction Management on their operations until you get things rolling. Our own experience had its share of lurches as we stopped for someone else to get on board. There is no pat answer to this problem. You must work at educating your key administrators and persevere to the end.

In terms of project scope, at a minimum you should have a project space program developed before looking for a Construction Manager. We at Penn State prefer to have the architect already on board and part of the Construction Management selection team. For the Hospital East Addition, we had a sketch design at this point as well as an overall project budget that was approved by the Pennsylvania Department of Health.

In establishing the scope of Construction Management services, there is need to address a series of questions best answered after analyzing the capabilities of your organization and architect. You will need to determine whether you will require a bondable Guaranteed Maximum Price or, rather, will use the Construction Manager as an agent with limited responsibilities. You will also need to decide whether or not construction will proceed on a fast-track basis.

A project with a well-defined scope and budget should benefit from a Guaranteed Maximum Price even though the Construction Manager will charge a higher fee for accepting this risk. To use the Construction Manager as an agent means that your institution will hold and process a score of trade contracts as well as hold the risk of maintaining the bottom line. Can you afford to bear that risk and can your accounts payable people handle the workload? The current trend of owners is towards bondable Guaranteed Maximum Price Construction Management contracts.

Fast-track construction is not for everyone. Fast-track construction requires an owner who can anticipate project needs in advance. It is a heads-up, fast-moving process that can collapse under the weight of a bureaucratic, committee-bound, decision-making structure. Some projects are not large enough to warrant fast-tracking. Some architects are not capable of preparing an effective set of early scope drawings. Most disputes on fast-track projects stem from ambiguity in scope of work documentation. Some architects are not accustomed to preparing individual bid packages on a tight schedule. If you have any doubts about the ability of your organization or your architect to keep up with the fast-track process, make changes or do not go fast-track.

Requesting Qualifications

Construction Management firms vary widely in size, type, and specialty experience. In the case of the Hospital East Addition, we were looking for seasoned practitioners having a depth of organization and a level of experience capable of routinely handling a $20,000,000 critical care facility. Our objective was to find firms who had at least five such projects completed or under construction within the past five years. We found three firms whose credentials more than satisfied the target criteria.

Our request for qualifications consisted of a two-page letter distributed by electronic facsimile transmission to the 26 firms who had contacted us over the past two years. The letter stated the project name, architect, range of cost, focus of the building program (surgical intensive care), and that we would require pre-construction services and sought to enter into a bonded Guaranteed Maximum Price contract for construction. The letter also gave critical schedule milestones. Finally, the letter requested, for no more than five sample projects, the name, status, location, square footage, construction cost, contract type (i.e., Guaranteed Maximum

Price/Construction Management, agency construction management, general contract), and architect and owner contact telephone numbers.

Requesting Proposals

The next step in the selection process is to request and evaluate proposals from the pre-qualified firms. The object here is to collect comparable proposals. In the case of the Hospital East Addition, we took great pains to make certain that all proposals were presented on an "apples-to-apples" basis. This step included a detailed request for proposal, individual orientation sessions, interviews, and a structured evaluation process.

The request for proposal should lay out a clear description of the project, the services required, the proposed form of agreement and general conditions of the contract, schedule milestones, and the format for responses. Along with a one-page summary project description of the Hospital East Addition, we included diagrammatic site and floor plans and a perspective drawing. A three-page description of required services laid out basic procedures and required services to be covered at: the contract document phase (before and after acceptance of the Guaranteed Maximum Price); the bidding and award phase; the construction phase; the beneficial occupancy phase. The form of proposal was split into two parts. Volume I addressed the non-financial aspects. This included identification of key personnel with resumes and client references, description of management approach, allocation of reimbursable and non-reimbursable personnel, and an estimate of time required to complete construction. Volume II laid out the format for presenting the lump sum fee for pre-construction services, the Guaranteed Maximum Price management fee as a percentage of construction costs, and the estimated amount of reimbursable costs associated with construction.

We worked at making the orientation sessions as thorough as possible. We encouraged the candidate firms to send their proposed project team to the sessions. This had the side benefit of allowing our staff an opportunity to informally observe the working style and approach of the teams. Each team was given two orientation sessions, one at the architect's office and the other at the project site. We used a set outline and checklist for these sessions to insure that each individual session was reasonably consistent with the others. We feel that the individual sessions offered an opportunity for dialog with the candidates that would have been missed in a common group orientation.

After orientation, the firms were given about a week to submit the proposal in two separately-bound and sealed volumes. Volume I was immediately distributed to the selection committee along with an itemized ballot form complete with scoring instructions. The ballots were collected at the start of the interview session, tallied, and returned to the committee. A fresh set of ballots were given out for the oral presentations. At the end of the interviews, the ballots were again collected and tallied. After reviewing the results of both tallies with the committee, we opened Volume II which contained the proposed rates of compensation. While the evaluation process was carefully structured, the final decisions were made within the context of group deliberation, debate, and consensus making. The detailed evaluation scoring system was strictly a tool to aid the individual members in understanding the group's perception of the candidates.

The interview sessions were targeted at evaluating the quality and organizational fit of the respective project teams. We worked at taking the interview out of the hands of the candidate's business development/ sales force. Rather, we set about to directly question the project estimator, the project manager, and the field superintendent that would be assigned to the project. The firm's introductory remarks were limited to 15 minutes; the next 30 minutes were devoted to discussion of structured questions designed to give insight into the problem solving skills of the team. The following half hour was given to questions from the committee. The final wrap-up statement of each candidate was limited to five minutes. The organization of the interviews kept the focus where we wanted it, on the capabilities of the team being offered to manage our project.

Selection and Negotiation

In making the final selection and in negotiating with the preferred Construction Manager, it is important to have a clear picture of your own objectives for terms and compensation. It is also important to understand whether you are focusing on the best price among apparent equals or on getting the best price for a preferred team. In any case, it becomes essential to clarify the differences in services offered in order to see the real difference in proposed fee. In the case of the Hospital East Addition, the interview team came to the unanimous conclusion that all things being equal in terms of cost, they preferred one candidate over the others.

Before negotiating with the preferred candidate, we found it necessary to ask all three to resubmit their proposals based on a better definition of certain ambiguous terms. We were fortunate in that the preferred candidate also offered the lowest fee. The second round of proposals allowed us to identify certain features offered by the other candidates and negotiate them into the preferred candidate's proposal at no increase in fee. This result met our objective which was to reach an agreement with the favored candidate at a cost no higher than the first runner-up.

Contracting Procedures/Forms

There are several standard forms of agreement available published by the American Institute of Architects and the Associated General Contractors. Penn State uses its own customized document prepared in concert with our legal counsel. It is absolutely vital that the Construction Management form of agreement be integrated with the General Conditions of the Contract and the Owner/Architect form of agreement.

One feature of the Penn State form of agreement is an option of a separate and severable agreement for services prior to acceptance of a Guaranteed Maximum Price. This allows us to terminate the relationship should we decide not to continue with the Construction Manager for construction of the project. On the other hand, the agreement provides for the pre-construction phase fee to be credited to future payments for services rendered after acceptance of the Guaranteed Maximum Price.

A major consideration in the drafting of a Guaranteed Maximum Price agreement is the distribution of savings. Some prefer to share a portion of the savings with the Construction Manager. At the Medical Center, we feel that this incentive focuses the Construction Manager's attention at the wrong area at the wrong time. The time for Value Engineering is during the pre-construction phase. Proper control over trade contract bidding is the best insurance for getting the lowest possible price for the specified work. For this reason, we call for 100 percent of the savings to return to the Medical Center.

Another feature of the Penn State agreement is that all construction in place must be performed under competitively bid trade contracts. At the Medical Center, we require the Construction Manager to collect a minimum of three bids, then narrow the field of bidders for detailed review to the three lowest bidders as finalists. The Construction Manager must then analyze the finalist bids and issue addenda and collect bid adjustments where required to confirm that all bids have been submitted on an equal basis. The trade contract is then awarded to the lowest bidder pending satisfactory confirmation of references. Strict confidentiality of all bids throughout the bidding and award process is vital to the success of this approach.

A Large Project

The Hospital East Addition is a 110,000 square foot addition to the University Hospital that includes a 24-bed surgical intensive care unit, main entrance lobby, admitting and pre-admissions center, and other patient care, support, and administrative spaces. The construction budget is in the order of $18,000,000. The project site posed a number of logistical problems. Most visitors and patients entered the hospital through this area. The site contained active sewer lines, and it overlapped the site of a project being built separately by a state agency.

There were numerous reasons for pursuing Construction Management on this project. The hospital needed early delivery of intensive care beds. Solutions to logistical problems at the site would have been difficult to bid accurately, and the project budget required extensive Value Engineering in order to meet the program.

Penn State had never taken on a project of this size and complexity using Construction Management before. Basically, we had to develop the process from scratch, standard contract forms and all. Furthermore, many administrators were not comfortable with the idea of building without a competitively bid lump sum price in hand. There was a fear that an out-of-control cost-plus contract would lead to disastrous budget overruns. It became our mission to prove that a fast-track Construction Management contract can be managed as tightly as any lump sum general contract, if not more so.

The exhaustive selection process delivered a high-quality Construction Management team to the project, a team specifically picked for their skill, not their low bid. This project would have lost much valuable time reconciling the program with the budget were it not for the Value Engineering that occurred in the pre-construction phase. In this instance, Value Engineering pared significant costs from the structural system and exterior cladding without compromising Penn State's design standards for the Medical Center. Fast-track construction has allowed us to take full advantage of a mild winter, breaking ground in January. Fast-track has given us some anxious moments as we were bidding window systems before the principal administrators could meet to approve the exterior design, but this same time pressure has forced us to make decisions where we would otherwise be tempted to deliberate further. We have found that Construction Management results in higher quality on-site management that is immediately obvious when you compare the housekeeping of this job site with that of its immediately adjacent neighbor. Of course, the bottom line is that the project is continuing towards its July 1, 1991 completion date on time and under budget.

A Small Project

The Magnetic Resonance Imaging (MRI) Facility Expansion project at first did not appear to be a candidate for Construction Management. The 6,500 square foot project did not seem large enough. This research addition would roughly double the size of the existing building and house all current MRI research staff and equipment, plus a new, 4.0 tesla, large bore magnet. However, the $800,000 construction budget could not be reconciled with the building program. The project is on a sloping site requiring extensive excavation. The research nature of the building complicated the heating, ventilating, and air conditioning system. Finally, ferrous metal cannot be used within the primary fields of research magnets, again adding to the cost of the structure.

We had reached the 50 percent working drawing stage when it became doubtful whether or not the architect's construction estimate would hold up at bid opening. We asked the Construction Manager for the Hospital East Addition to prepare an estimate while the working drawings were still in production. This approach preserved the option of either continuing on with lump sum bidding or entering into a Guaranteed Maximum Price agreement with the Construction Manager.

The Construction Manager's estimate turned out to be over 25 percent higher than that done earlier by the architect. Examination of detailed breakdowns of both estimates satisfied us that the architect's estimate was incomplete in certain critical areas and that redesign would be unavoidable if we were to stay within budget. The project budget was salvaged by a team effort of owner, architect, and Construction Manager to reduce the scope of work and reduce costs through Value Engineering.

Although this project eventually used Construction Management, it was not fast-tracked. It took about three weeks to take the construction documents from 50 percent to 95 percent completion. Given the short period of time to develop the construction documents on a job of this size, there was no reason to use the fast-track process. In this case, the Value Engineering aspect proved Construction Management to be viable for a project too small to warrant fast-track construction.

A Large Project Without Construction Management

The Biomedical Research Building would appear to be a classic candidate for Construction Management. A 250,000 square foot laboratory/classroom/office facility with a construction cost of over $37,000,000 is certainly large enough to be fast-tracked.

In this case, the building site could not be made available until the spring of this year. With this constraint in place, there was plenty of time to fully develop drawings for lump sum bidding. The project was large enough to warrant hiring a qualified independent cost estimating consultant who performed very well. The final estimate ended up equaling the average of the qualified bids with the low bid being substantially below the estimate. In this case then, we saved money by bidding the job.

Summary

Construction Management is an option that offers owners much greater involvement in the construction of facilities, involvement that can bring the benefit of greater control to direct project resources to the best advantage. This is especially important on large or complex projects. CM can also be very useful in cases where the project schedule or budget is a concern. While not appropriate for all projects, Construction Management is a powerful tool in the hands of the owner who can implement the appropriate processes. However, CM is a different way of doing business for most colleges and universities, and it does take some time for those involved in projects to learn the procedures and become comfortable with the approach. If you are considering the use of CM, it would be worth your while to talk with several firms to find out what services they offer and how they work. You might want to look specifically for firms who have college and university experience. Their understanding of how you function can make things easier. Once this is done, you need to sell your administration on the concept; if they are not comfortable with it from the outset, you could have problems later on. Once you begin using CM, expect to learn from your experiences. We at Penn State have not had unqualified successes with all our CM ventures. But overall, we are well pleased with the results and plan to expand our use of CM on selected projects in the future.

Utilities Master Planning in the Campus Setting

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This article discusses the benefits that utilities master planning can give to a campus. A rational means of performing this function is discussed with examples of how it is being carried out at the California State University (CSU). Utilities master planning allows for much more predictable forecasting of cash flows and reduces surprises.

Historically, most campuses have institutionalized an architectural campus master planning function. These planning functions site buildings, chart program growth, arrange financing, and develop projects. Utilities Master Planning at the same time is relatively uncommon. Normal practice is to add buildings to existing utilities networks until failures occur due to age or overload. This lack of utilities planning is costly. As failures occur, portions of the existing campus and sometimes new buildings are forced out of service by failures. These failures require time and the extra added costs of emergency repairs to put back into service.

The CSU is successfully establishing utilities master planning as a complement to the architectural master planning concept. While some approaches are borrowed from the architectural methods, others are more analytical. This procedure, properly done, can solve many of the infrastructure problems faced by campuses today. Utilities master planning integrates two goals: defining the present state of each of the utilities on a campus, plus projecting the increases in service needs due to program changes or new buildings being added. A consolidated growth and cash flow plan is then prepared to obtain funding and implement the changes defined. The major benefits utilities master planning are predictability and quantification of costs to funding agencies.

The CSU system is dynamic and is updated periodically. An update cycle of three years has been chosen by the CSU. This interval corresponds to the normal funding cycle of the California Legislature. We submit items identified for improvement to the legislature in the first year. Design funding is normally granted in the second year, and construction is funded in the third year. By the third year, additional programs and buildings from the architectural planning process will require integration into a plan revision. The first impacts of the initial utilities master plans will be in place. A renewed look at the utilities master plan in the third year allows for program corrections to address changes that have occurred from that contemplated initially.

Background

To give readers a sense of the background for developing the utilities master planning concept, this section describes the CSU system, its age, and its growth. While the CSU was founded in 1857, it grew slowly until after World War II. California built most of the CSU campuses (15 of 20) between 1950 and 1970. Current system enrollment is roughly 250,000 FTE (Full Time Equivalent) students. Growth projections suggest that enrollment will increase to more than 300,000 FTE by the turn of the century.

Until 1970, the State of California's Office of Architecture and Construction (OAC) performed all campus design. OAC was an in house architectural and engineering operation headquartered in Sacramento. The present campuses were designed with whatever utilities system was in favor by the project engineer at that time. Thus some campuses have central utilities, other local building utilities. Some campuses have central cooling with chilled water, some have rooftop package heating and cooling units. Some campuses have centrally metered gas service, others have local gas meters at each building. Little continuity in the area of utilities planning is apparent to the outside observer. Since 1970, private sector architects and engineers have designed CSU projects.

Because of the age of the campuses, major equipment failures are occurring with ever more frequency due to age. In the past year, major electrical feeder failures have occurred at three sites. Chiller failures have occurred at three sites. Boiler failures have occurred at two sites. Many distribution failures (Steam, Chilled Water, Heating Water) have occurred throughout the system. These failures have historically been handled out of a special repairs budget. This budget has been about $10 million per year. Recent failures have put a strain on this budget (which also handles roof repairs and emergencies other than earthquake repairs).

After enrollment stabilization and funding cuts of late 1970's and early 1980's, enrollment is growing again. Between 1970 and the early 1980's, CSU enrollment was stable and little construction occurred. With the passage of the Gann property tax limit (Proposition 13), funding sources for the CSU were severely crimped as the State was forced to cover added funding for the Community College system from an essentially fixed state funds resource. CSU deferred maintenance and cut staff in the early 1980's to meet budget resources.

While the 18-24 year old age group that has been the backbone of university enrollment is declining in California, enrollment figures at the CSU are climbing rapidly. This growth has been traced to many persons returning for degree programs and supplemental classes later in life. CSU is meeting this need with new construction. This construction is adding to loads on the old, already overtaxed, existing systems.

Still another feature of California is its strong environmental posture. Environmental regulations are adding uncertainty to the utilities planning decisions that used to be almost automatic in nature. Air quality districts (prodded by the U.S. Environmental Protection gency) are enforcing strong and costly changes to boiler emissions and chlorofluorocarbons emission regulations.

Most utilities projects done by the CSU in the past ten years have been the result of responses to emergency situations. These situations have included: Failure of a service or meeting the capacity needs of the next building coming onto the line. Because central plants lacked capacity, many new buildings have been served by local systems such as roof top air conditioners. Local equipment has been the only choice even though it has much shorter equipment life and added maintenance costs.

Little if any long range utilities planning to meet incipient needs has been done at CSU. All of the forces mentioned above have combined to make utilities master planning a necessity at the CSU. We performed our initial utilities master planning project at our Fresno campus in 1988. The results of that effort convinced management that this approach warranted systemwide implementation. In the spring of 1989, the Trustees of the CSU passed an executive order empowering the Chancellor to enforce a policy of using life cycle costing for all future work within the CSU. This policy set the stage for the utilities master planning effort. The following section describes in detail the procedure used at CSU Fresno and proposed at the other 19 CSU campuses during the next three years.

Procedure

There are 66 employees in the CSU Physical Planning and Development (PP&D) staff. PP&D is responsible for the administration of all 20 CSU campuses. Of this staff, seven are handle the area of energy and utilities. Other groups handle architectural master planning, architectural design administration, and project construction bidding, administration, and inspection. The seven utilities personnel include: three engineering personnel, two administrative personnel handling the utilities consumption and budget data bases, and two clerical staff. It was clear that while utilities master planning was desirable, internal staff could not handle such a task. To this end, we prepared a detailed scope of work for issuance to consulting engineering firms. The paragraphs below describe the scope of work chosen and why each task was included.

Inventory the existing campus building systems.

Existing buildings frequently have their functions and occupancies changed. These changes are seldom recorded. Changes include not only program changes but also the addition and removal of walls. It is essential that the consultant conduct a field inventory to determine what is actually happening. This field survey will usually elicit local energy conservation opportunities for inclusion in the utilities master plan process.

Inventory the existing infrastructure and plant.

Again, the existing plant and its distribution systems have frequently had many changes made during their installed lives. Frequently, emergency repairs are made with no documentation. Equipment is often out of production or manufacture and requires study to determine functionality in the field.

Inventory the staff and their capabilities.

Consultants frequently overlook this step. Staff capabilities should be defined by interview. Operating engineering staff qualifications vary substantially by location. Some sites have very sharp staff in particular areas while they are weak in others. Simultaneously, the consultant should rate the adequacy of the staff in meeting the assigned maintenance needs of the campus. If staff have been reduced in force to meet budget demands, no matter how competent they are, tasks will be neglected. Solutions proposed for a utilities masterplan should include staff input, skill levels, and availability. To propose solutions that increase staff effort or require obscure technologies on a campus are almost always doomed to failure.

Define the campus growth projected.

This step involves a series of interviews with campus planning, campus architects, and chancellor's office staff. Growth should be clearly projected for a three to five year period. The consultant should construct a less focused view of growth to the twelfth year beyond the completion of the utilities master plan. Campus growth can occur both with the building of new structures or remodels and the removal of outdated buildings. The consultant should pay particular attention to older buildings that, while not historic, may be removed for program or structural deficiency reasons. Large investments in infrastructure to such old buildings should be avoided.

Prepare an energy model of the present buildings and campus.

The importance of this step can not be over emphasized. An energy model, once created can be a living test bed of the campus. The campus or consultants can try concepts in the model without investing huge sums for ill-conceived capital projects. The energy model allows the campus to be operated in much the same way as microcomputers allow airplane flights to be simulated.

The model used by the CSU is the DOE-2 computer energy use model. While there are other energy models available, DOE-2 has received the most funding and support over the years. Developed initially by the California Energy Commission, the program has been supported for the past 12 years by the U.S. Department of Energy and the Lawrence Berkeley Laboratory. DOE-2 is a public domain program that will simulate virtually any campus. The DOE-2 program is used by a fairly broad number of engineering firms and sub-consultant specialists allowing a fair market of costs for its use. Initially, the consultant prepares models for each campus building reflecting that building's particular characteristics (lighting, insulation, occupancy, function, and orientation). These single building models are then combined into a campus model. The campus model includes the central plant if any, and the pumping and piping systems flows.

Calibrate the model to historical records. A model is only as good as it can model the recent past. At the same time, models normally use an average weather year so it is important to take a three year average of campus utilities needs against which to compare the model. This last step tries to assure that singularly hot or cold years are "filtered out." At this stage, the models may show major anomalies. These anomalies are frequently due to overlooked loads, equipment operation, or due to equipment operation at much poorer efficiencies than expected. The engineer should determine to all parties satisfaction the causes of such anomalies before proceeding further. A model that gives results for the existing campus within plus or minus 15 percent of actual energy use is valid.

Explore improvements to buildings first. Once the base model is calibrated, attention then returns to the individual buildings. If you can improve a building's energy use, this should be done before approaching a campus wide solution. As an example, suppose that you could reduce lighting wattage by half while maintaining the same visual comfort. Reducing the lighting wattage would cut local cooling needs by about 1/3 watt for every watt of lighting removed. Were a cogeneration system to be installed, you would want to install it for the remaining wattage of lighting rather than for the initial inefficient lighting (assuming that the life cycle cost of the lighting is less than that of the cogeneration system). Normally, the consultant should look at the improvements to the lighting and skin first. Examples of lighting improvements that we have seen to be cost effective include: occupancy sensors, optical reflectors, biaxial fluorescent lamps in place of incandescent lamps, and electronic ballasts with high efficiency lamps.

Once cost effective improvements to the lighting and skin have been approved, then the heating, ventilating and air conditioning (HVAC) systems at the building level should be explored for opportunities. The CSU has found effective options to include: variable or two speed fan controls and discriminator (deck reset) sensors.

At this stage, the consultant should make recommendations at the building level for those measures which offer the best economic life cycle performance. This point is a good time to get a progress report from the consultant and to review progress as noted below.

Add future campus growth to the model. Once the existing campus building models are complete, it is time to return to the whole campus model with the cost effective building modifications incorporated. Then new buildings are added to the model. Many engineers balk at performing energy models of buildings at the planning stage. This is, in fact, a perfectly good time to model them. Usually, new buildings have known areas, heights, and program function. Their schedule will more often than not be similar to a present building with similar educational program. While final architectural details are not fixed, model results will be near the same range of accuracy as the campus model. Adding these buildings will show their impact on the central systems.

Explore central systems improvements. At this time, data is now in hand to explore the central or campus wide measures. Not only is the energy model necessary here but also models of the flow systems and the electrical systems are required. The results of the energy model can provide valuable input to the electrical power and flow models to define the peak demands needed during the average year. The consultant should model each service at this point both for its adequacy to meet present needs and for the impact of future expansion and changes. The systems to be explored should include: (1) Heating and Cooling Distribution (2) Boiler plant(s) (3) Chiller plant(s) (4) Incoming Electrical Service(s) (5) Water distribution (6) Sanitary Sewer (7) Storm Sewer (8) Natural Gas (9) Voice Communication (10) Data Communication. Quantify each option explored by Net Present Value (Life Cycle Cost).

Life Cycle Costing is a variation of the finance theory of Net Present Value. A life cycle evaluation of first costs, equipment lifetime, energy, other utility, and staff maintenance costs provides a single number. This number is the present worth of all cash flows associated with a particular utilities strategy. In finance, the project with the largest net present value is chosen. Since most utilities projects involve replacing or enlarging existing services, there is seldom a positive present value (there would be if energy savings over time exceeded capital costs plus maintenance). More often than not in a campus setting, calculating net present values will give negative results. To use NPV would require choosing the option with the least negative (i.e. most positive) value. Negative numbers confuse most people. Life cycle costing merely multiplies negative terms in the net present value equation by minus one to get positive values. One than chooses the project with the least life cycle cost to get the same result as if NPV were used.

For each option the consultant then prepares a matrix of first costs, operating costs (energy and operating staff), maintenance costs (contracts, overhauls) and life cycle cost. The CSU provides their consultants with the input of discounted cost of funds and project horizon. The cost of funds is that cost at which the CSU can issue municipal bonds (7.5 percent). The economic horizon is that view to the future over which options should be considered (CSU recommends 24 years).

Prepare 3, 6, 12, and 24 year masterplan scenarios.

The CSU recommends that consultants then prepare four utilities master plan scenarios. The first is a three year scenario reflects immediate needs, allows legislative funding process. The second scenario, taken over a six year perspective reflects near term growth. A 12 year scenario looks at mid-term needs at major systems level. Finally, a 24 year scenario looks one major life cycle into the future.

Presentation.

The Utilities Master Plan must be prepared in a format that can be excerpted for use in preparing capital outlay budget requests. Providing the consultant with a structure of presentation in this area is invaluable. With the limited staff that we have, to be able to excerpt text in a form easy to use by the executive and legislative branches is important.

Prequalify Utilities Master Planning Consultants Thoroughly

The CSU has found that engineering firms are eager to perform this service. Nevertheless, many firms lack qualifications. Some firms look upon this type of work as fill-in work for their staff. Still others look at it as training grounds for their junior staff. Still others see only a small part of the picture. To be successful, consultants must be comfortable with energy modeling--the most complex feature of utilities master planning. Consultants must be large enough to handle an entire campus in a reasonable time frame. Consultants must have experienced designing campus utilities systems, not just preparing studies. No discussion of consultant selection would be complete without emphasizing the checking of a consultant's references thoroughly for past similar experience.

Define intermediate milestones and fixed time frame

There are several other steps that can assure a good, strong utilities master plan. Define up front, a clear, concise timeframe for the consulting firm to complete its work. Require the consultant to submit outlines of progress no less than monthly. Meet frequently to assure that all parties are "on the same track." Involve campus staff and planners to assure that they are "bought into" the consultant's recommendations. No matter how well intentioned the consultant's ideas, unless those on the campus who will have to live with them are comfortable with them they will either go nowhere or fail. Involve those persons who will fund resulting projects to assure their comfort level with the ideas proposed. Request the consultant to use Critical Path methods to define and maintain the project timeframe.

Obtain Both Written Report and Computer Readable Data

One of the most important aspects of taking this approach to utilities master planning, is the fact that it can be used in many ways. For those with more astute campus staffs, the staff can use the model to try new ideas themselves before implementing them. For others, the ability to have all data in hand can permit avoiding the "sole source" pitfall of having only one firm able to perform later analyses. Certain other items should be obtained in the preparation of a utilities master plan. The following paragraphs discuss these items.

The report should include an executive summary written in lay terms. Frequently, engineers will write a report suitable for other engineers to read rather than the decision makers. We recommend that the consultant be explicitly requested to write the executive summary in language emphasizing the financial impacts of the proposed utilities master plan.

The remainder of report should be a road map of future utilities development to meet both replacement of failed, outmoded systems and accommodation of future campus growth. We recommend that the report include chapters describing: the calculation procedure, the results of personal interviews and the growth projections for the campus. Specific chapters should address those measures recommended for implementation in the individual buildings and those for implementation at the campus level.

The report should address all components of each option considered: (1) First Cost (2) Energy Cost (3) Maintenance Cost.

These costs should include life cycle costs for each measure proposed. In this way financial decision makers can rank and determine those projects on which to proceed. Equally important, the consultant should describe briefly those projects considered but found to have flaws. By listing unsatisfactory projects, many questions asked during the funding phase (Have you considered ...) may be avoided.

The CSU recommends the use of a set of report preparation standards. Foremost among these standards is mandatory double sided copying of the final report. It is recommended that the body of the report use 12 point type and that footnote use 10 point type. While it is desirable to see those relevant pages of calculations prepared for a utilities masterplan, the sheer bulk of the calculations necessary prevents including the entire calculation stream with the final report. We request consultants to include pertinent calculations within a set of appendices. Other requirements that we have found useful include the use of tables of contents, a list of figures, a list of tables, and a glossary of terms for the non-technical readers. Where useful (such a piping flow diagrams) we recommend the use of color copying techniques in those copies directed to decision makers. For this class of document, we recommend that all figures be drawn using computer graphics. This last recommendation provides much clearer text than hand lettering and reproduces better.

Finally, we recommend that you obtain a copy of the input and intermediate files of the energy model and any distribution models used. In this way if you are unsatisfied with the consultant's work or if changes occur in the firm, these source documents can be given to another consultant (to update the utilities master plan some years hence).

Future Potentials

Once you have the energy model in hand you (or consultants) can explore several issues: alternative fuel choices (gas vs. oil), alternative rate structures for utilities, and the effects of funding changes on recommendations. How many times would you like to have known the effect of the next utility rate increase before it occurred? What if funds became available for utilities projects from unexpected sources? What would be the impact of installing a new lamp or ballast combination or the effect of a new donor funded building? You can answer all of the above questions can be answered with the energy model. Likewise, you can use distribution models can be used to explore the effects of adding loads to electrical feeders, or to existing piping systems.

Having the energy model in hand allows selection of other consultants for future revisions if necessary. As everyone appreciates, the changes that occur in the consulting industry require that a campus not "marry" itself to a single engineering firm. With the frequent staff turnover in today's engineering and architectural firms, having the models in hand assures that the utilities master plan developed today can be maintained in future years. If the models are not obtained in electronically readable form, future consultants would need to start over to reconstruct the models. We recommend that the models be obtained in standard IBM compatible floppy disks. You should check and back up these disks upon receipt.

Costs

Our experience at the CSU suggests that for large campuses the cost of preparing a utilities master plan is about US $0.10 per square foot (US $1.00 per sq. m). Small campuses (less than 1,000,000 square feet [110,000 sq. m]) could expect a threshold cost of US $100,000. We would urge that in any requests for
proposal from consultants you request the consultants to provide a price breakdown by one or more of the following categorical arrangements. In this way, you can see whether the consulting firm will be devoting its efforts in proportion to the campus' needs.

1. These costs break down roughly by service as follows: (1) Electrical -- 40 Percent (2) Mechanical -- 40 Percent (3) Civil -- 20 Percent

2. We have found that costs break down by campus elements as follows: (1) Buildings -- 45 Percent (2) Distribution -- 20 Percent (3) Central Systems -- 35 Percent

3. We have found a cost breakdown by the consultant's activities as follows: (1) Campus site visit and model description -- 40 Percent (2) Modeling and exploring options -- 20 Percent (3) Draft report preparation -- 20 Percent (4) Final report preparation -- 10 Percent (5) Presentations -- 10 Percent

Though we have not yet cycled through our first three year revisions, our discussions with consultants have projected that follow-on study revisions should be about one tenth of the initial cost. As noted above, we recommend that revisions to the utilities master plan be made every third year. We feel that for most campuses and systems to do a revision in less time would spend funds unwisely. To exceed five years would allow so many changes to occur that the master planning process would have to begin anew.

Benefits

A coherent utilities master plan allows meaningful budget planning with justification. You can propose capital outlay budgets for five years in advance. So often, project planning occurs on the spur of the moment as funding sources dictate. Buildings are built with services that can not support them. The utilities master plan gives reason to a long range strategy to provide services, and reduce both energy and maintenance costs over time.

The utilities master plan text gives draft justification language for proposed projects. With the justification text in hand, projects can proceed more successfully through the administrative and legislative hearing process. You can counter questions and objections with the fact that the projects proposed are part of an integrated whole rather than of the moment.

You can use a utilities master plan to plan future expansions proactively rather than retroactively. Utilities replacement projects can include capacity for future growth. You can replace utilities near the ends of their predicted useful lives before catastrophic failure.

Summary

The CSU system believes the utilities master planning concept provides special benefits realized by few campuses or systems today these are:

1. Utilities master planning parallels the architectural master planning process and is an orderly extension of it.

2. Utilities master planning establishes a structured pattern for utilities growth and replacement.

3. Utilities master planning provides justification of a 5 year capital outlay program for utilities related projects.

4. Utilities master planning permits alternate utility rate and fuel arbitrage studies.

5. Utilities master plans can be updated periodically at relatively low cost.

6. Utilities master planning provides the decision tool for the best use of limited capital resources.

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Site Planning and Management: An International Review

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Introduction

Space allocation in an institution probably approaches parking as one of the most emotive issues that confront the facilities manager.

How often do we find that the first rule of space allocation negotiations is perceived to be "What's mine is mine and what's yours is negotiable". Everyone believes their need to be greatest, requiring least justification and beyond the normal parameters which one usually applies to space planning.

The situation is not limited to intra-institutional space dealings. Universities and colleges compete for capital in state-funded programs, each believing theirs to be the most worthy project for consideration by whichever Government department or political process that makes the final determination.

Government departments of course have to compete for their share of the tax-dollar. As the ever-dominant Finance Department strives to reduce expenditure in all programs, capital expenditure is a candidate for scrutiny.

A very basic review of some statistical data reveals the following: in the United States of America some 3300 institutions of higher education have space holdings of 3 billion gross square feet valued at least at $300 billion; twenty-one universities in Australia in 1988 reported space holdings of some 30 million gross square feet with a value of $5.5 billion; the province of Ontario, Canada has nineteen institutions which have some 25 million gross square feet; 48 institutions in the United Kingdom have space holdings of some 120 million gross square feet, valued at £6 billion. Even such basic data indicates the magnitude of the resources which are being managed.

Space planning and management carried out on a rational basis is therefore not a luxury but a necessity at all levels of negotiation although the detail which might be required by the hierarchy of decision-making will be different.

Many agencies have devoted extensive resources to the problem, adopting a variety of approaches to define in various ways, the amount of space needed to meet the needs of academic institutions involved in varied mixes of teaching and research, over the full range of disciplines. Recent years have shown that for many of the activities involved there is no permanent answer. Technological evolution applies to research and teaching; the amount of space needed changes accordingly.

This paper describes the international search for a system that would be suitable for adoption in Australia and the principal characteristics of the systems examined. An extensive international bibliography was assembled. A selected bibliography is appended.

The Realities of Space Management

In an ideal situation, each institution would of course have all the space it needed as would every academic activity in the institution. Allocation might be totally automated based on very scientific measures of space standards for each discipline. The space manager would simply enter the institution or department's name into the computer and have generated the space entitlement to accommodate the functions.

However the real world is very different. Quite often new academic initiatives are begun without any reference to the space needs. Research funding is drawn to the institution on the reputation of researchers who then proceed to demand that space be provided for the research staff and equipment required for the work.

The reality of space management at the micro scale is therefore that it follows the academic development of the institution. This is not a bad thing in itself provided that planning at the macro level has provided sufficient flexibility for such planning adjustments to be made.

There are various "styles" of space management: these can be loosely described as follows:

- "seat of pants" Some might describe this as intuitive management. It might be suitable in the short term for very small institutions. This type of space management soon comes unstuck.

- "crisis driven" Any institution that allows its space planning and allocation to be crisis driven will usually have an inefficient process. It is likely that some elements will have too much while other elements will have too little space.

- "formula driven" Such systems tend to be regarded as more equitable than either of the above as they tend to reflect norms and standards for functional use. However they can be used as blunt instruments and this can perhaps be regarded as the biggest disadvantage of such systems.

- "needs driven" A truly needs based space planning and management system would be regarded as the fairest system of all. However it is likely that the amount of effort required to implement such a system would outweigh the relative advantage.

Inevitably the final application involves elements of all. In broad terms however, it was generally agreed without serious dispute that the basis of a system that could result in a rational and equitable distribution of capital resources must be fundamentally formula driven, the formula providing the basic measure, the actual allocations being adjusted "on the fringes" by specific local needs, especially those of research.

The Australian Experience

Like many countries with Government funded higher education, the Australian system has suffered major changes according to political circumstances. In the last 20 years, Government control has changed from being focussed on a central Commission that advised Government in quite detailed terms, assessing needs without political bias, to the present, where there is direct control by the Commonwealth Department of Employment, Education and Training. While the earlier Commission had developed basic space standards, largely modelled on those of the British University Grants Committee, the evolutionary process has led to all standards being discarded, and now to a decision to re-establish them.

Associated with any planning process there must also be a systematic and comprehensive space inventory. It should be capable of operation at two major levels, firstly providing that information required for central government purposes, and secondly that necessary for campus asset management. The former would be standard for all institutions, the latter capable of being tailored to meet local institutional circumstances.

Space planning and management in Australia is therefore at the crossroads. Although there has been no system-wide measure of space efficiency, some individual institutions have developed their own systems based on a range of norms, rules of thumb and experience. Some universities continued to maintain space inventory data as an internal management tool. However no cohesive Space Planning and Management System has existed.

As a result, a working party established the Australian Vice-Chancellors' Committee and consisting of facilities managers began work on the development of a set of guidelines for a uniform space inventory system and a computerised space model to be adopted by all universities in Australia. At about the same time, the Commonwealth Department of Employment, Education and Training established another working party to develop a space planning and management system. Fortunately, the co-operation between the two groups has led to the co-ordination of the work and a significant amount of cross membership of the working parties so as to eliminate duplication.

Space Inventory

A computerised, data-based, space inventory system has been developed which adopts the room as the basic building block of space for which data is collected. The data collection is divided into "essential" and "discretionary" groups and a complete set of definitions is provided so that cross institutional comparisons of like areas may be made.

Institutions are required by the Commonwealth Department of Employment, Education and Training (DEET) to collect the data in the "essential" data fields: however, institutions may collect as much or as little of the other data as they wish for their own management purposes. In this way, DEET has the data it needs to establish space held by institutions in a broad range of categories, while the institutions can determine their own needs for management reporting.

Data is collected as a database, enabling manipulation by the user to output customised reports. Data for DEET is returned as an ASCII file which the Department is able to manipulate as it requires.

The essential data collected can be summarised as follows:

a) From Room Data Sheet

- Institution Name
- Campus
- Building Number and/or Name
- Room Allocation
- Room Usable Floor Area (UFA)
- No of Teaching Places
- Room Condition
- DEET Organisational Unit Code

b) From Building Data Sheet

- Institution Name
- Campus
- Building Number and/or Name
- Building Gross Floor Area (GFA)
- Building Usable Floor Area (UFA)
- Building Ownership
- Building Condition

Such data will allow the following reports to be produced without any degree of difficulty:

- Report of Total Space Holdings. This report will provide a schedule of all buildings owned or operated by the institution including those not owned, together with their Gross Floor Area (GFA), Usable Floor Area (UFA) and building condition. The report will aggregate the total for the institution.
- Report of Non-Institution-Owned-but-used Space Holdings.
- Report of Holdings Owned by the Institution but not used for teaching or research or other function directly related to the institution's primary mission.
- Report of Space aggregated by Organisational Unit. This report would further define space by its condition.
- Reports by Campus. Each of the above Reports would also be able to be provided for each campus.

The format of data collection is set out in Appendix 1.

Space Planning - A Review

Whilst it is important to know how much space an institution has as a resource, it has become apparent that guidelines should be established for the allocation of space based on staff and student numbers and the space requirements of particular disciplines for teaching and research.

The AVCC Working Party had done a considerable amount of research on the various methods of space planning and their applicability to Australian Higher Education.

Through personal contacts and literature searches the United Kingdom, the United States of America, South Africa and Canada were identified as countries having space assessment systems that might be appropriate. It was not possible to review all in detail but typical examples were taken for assessment.

Basic measures used in their assessment were:

a) could they be operated without new statistical collections?

b) would they be effective within the general management systems applying? and

c) did their application provide a reasonable fit with the perceived needs and sizes of existing institutions?

Also of concern was their ability to be used for internal asset management purposes, and to be able to be operated on a range of computer systems.

Rapid changes in demand for facilities accompanying major shifts in government educational policy preclude any long term planning for development in detail.

Any formula adopted must be suitable for application over a wide range of institutional types, and its methodology and terminology clearly specified.

The following systems were reviewed in detail but discarded:

1. The Texas Co-ordinating Board, College and University System was examined in particular for its assignment of research space on the basis of X square metres per Y dollars

attracted for research purpose, an approach that initially was not accepted as being uniformly applicable across all disciplines, but one which, as a consequence of failure of other approaches to provide good solutions, is being re-examined.

2. The State University of New York System was examined because of the systematic build up of space needs from precisely defined elements. The system provides a step by step logical approach, and is designed to provide a campus space quota. In the Australian system, despite an overall campus assessment, building projects are allocated on the basis of verified need for specific activities. The inescapable conclusion was that the SUNY system would inevitably be applied on a micro rather than a macro basis, and not leave room to negotiate special needs. It was also perceived to require administrative resources beyond the scope of Australian Institutions.

3. The California Post Secondary Education Commission was carrying out contemporary work and large resources were being applied to development of a new system. This indicated that the system in use there no longer met needs. New work was not completed to a stage where results could be assessed.

4. The South African Secondary Education system proved to be of interest, but was based largely on the UGC system of the United Kingdom.

The Finalists

The assessment resolved itself to be one of direct comparison of the system used by the Universities Funding Commission (UFC) of the United Kingdom and that used by the Council of Ontario Universities (COU), which both had features of apparent merit.

The following highlight the main features of the systems, assess the practicality of operating either of them in Australia and compare aspects where their philosophies are at substantial variance.

Each system has been used for some years and is generally accepted in the area in which it operates. Each was founded on data provided from surveys of existing conditions, establishing formulae based upon average areas and usage. Whilst the basic philosophies differ, the results appear equally effective for their own users.

The Council of Ontario Universities' system of space guidelines appears to be based primarily on utilization factors such as student contact hours as well as the numbers of full time equivalent (FTE) staff and students.

The Universities Funding Commission's planning norms are built entirely on the basis of full time equivalent student numbers and staff/student ratios, although some utilization elements were used in its development.

A review of each of the main space type categories yielded the following comparisons.

1. Libraries

The UFC system uses FTE student numbers as an input measure, thereby limiting library size by enrolment; the COU system's formula is based, at least in the "Stack" component, on the volumes held; the "Study" component is based on FTE student numbers. Overall COU formula for libraries appears to have no size-limiting factor.

2. Lecture Theatres and Classrooms

The COU does not differentiate between such general teaching spaces, offering a straight area per FTE student overall. The UFC provides two straight lecture theatre formulae for Maths and non-Maths classes. It allows a component within each academic staff office (6.5 m^2) for tutorial teaching and two separate formulae for Arts and Science FTE in seminar/class/syndicate rooms. Whilst the overall space allowance under each system is similar, the UFC dictates three components of teaching space types, whereas the COU system allows total freedom within its formula for this space category.

3. Undergraduate Laboratories

The COU offers four space factors, dependent on discipline groups, per weekly student contact hour. The UFC allows one laboratory place per two undergraduate students in the first and second years and one place per student in third year. Space entitlement is then generated from the UFC's space standards, which vary by course type. As mentioned earlier, the COU relies on the "weekly student contact hour" factor to generate entitlements, a utilization measure unlikely to be readily available in Australian Universities. The UFC system appears more amenable to computer generation of space entitlements from data which is readily available in Institutions in Australia.

4. Postgraduate and Research

The COU provides 4 m^2 of office space per FTE graduate student and a range of five space factors apply to its "input measure" (FTE staff plus half FTE graduate students and non-faculty research staff) for laboratory space. The UFC allows a range of areas, depending on discipline, to provide study, laboratory, preparation, storage and other ancillary areas for graduate students within its norm groupings. The COU formula is simpler to calculate, however it is doubtful whether either would prove a completely satisfactory solution in itself. Cases would need to be judged on their merits, using formula-generated figures as a starting point only.

5. Offices

The COU provides for a 13 m^2 office module for all entitled staff, with an additional allowance of 15 percent, to encompass the need to accommodate part-time appointees, professors emeritus, visiting scholars etc. A further allowance of 30 percent of total office space is made for office service space.

The UFC's space standards for academic offices shows a range of areas (from 7.0 m^2 to 18.5 m^2) which are dependent on the discipline group. The total of such space is generated by the FTE student numbers, discipline group and staff/student ratios. Non-academic offices are allowed for on the basis of an area per FTE student. A further allowance is made for conference and committee rooms for Central Administration, again on the basis of total FTE student numbers.

Thus, the "core" of each system involves a basic office module allowance, with this being less evident in the UGC's case.

Review Conclusions

The review concluded with a decision to develop and apply the UFC system to a sample of Australian universities, in the belief that a relatively small amount of work would result in a useful outcome.

In the event, the result was very different. After testing an existing program it was found that the fit between the allocations generated and the actual situation on a range of campuses, old and new, large and small, was at variance beyond any reasonable acceptance. The variance occurred at both overall and at academic unit level. In many cases it was beyond the bounds of sensible explanation.

It was thus decided to develop a new local system.

An Australian Space Planning and Management System

DEET sought to establish a system which allows institutions to continue their own particular style of teaching and research but which was simple to use and required the collection of no additional statistical data other than that which was already collected. Such data, simply expressed, is the number of full time equivalent staff by function and organisational unit and the student load by discipline group.

By applying a set of space indicators to this data, a simple computer model will output the indicative space requirements for an institution as an aggregation of data produced by organisational unit or discipline group. Adjustments to reflect special equipment situations or abnormal requirements can be made by the space manager after investigation of these aspects. An institution is able to use such reports to compare its indicative space needs with its space holdings. If used at the organisational unit level, a simple management tool is developed for measuring relative need.

At the Commonwealth level, such a model is able to be used to establish the relative needs of the various institutions when bidding for additional capital funding.

The danger of course is that such systems can be, and are used in some places, as blunt instruments by funding authorities and it is essential that such usage is discouraged. Similarly, institutions might argue that space holdings are less than those indicated and that the funding authority has an obligation to fund new capital.

The intent of such a system however is not that it be definitive but that it enables relative needs to be established.

Space Indicators

The space norms developed in the UK and North America appear to be at odds with typical conditions found in a sample of six universities in Australia. As a result it has been decided to develop a set of Space Indicators which, while being based on these existing norms, will more closely reflect Australian conditions. An example of these is set out in Appendix 2. It should be stressed however that these are the subject of on-going refinement at this stage.

Research

The particular needs of research institutions are difficult to plan for in any system as research follows no set pattern. In major research universities in Australia, space for outside-funded or contracted research occupies between 10 and 15 percent of the space holdings of the university. Some systems attempt to provide space for these activities on a formula basis, driven either by the discipline group or by the amount of research funding attracted to the institution. However it is probably more reasonable to treat each case on its merit and complete a functional analysis of needs. More importantly such space might need to be funded entirely by the research project, a situation which presently is not common in Australia.

Conclusion

As we work towards the development of an integrated Space Planning and Management System, the importance of maintaining each institution's individuality becomes clearer. We believe a system which allows institutions to determine their own staff:student ratios, their particular needs according to discipline mix as well as the ability to justify particular requirements for equipment etc. will be better than a system which is

too rigid. There will of course be institutions which will be unhappy at the outcome in the short term as some institutions will have space holdings in excess of the space indicated by the model. In the long term however, Australian Higher Education overall will benefit as resources are applied to needs.

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HIGHER EDUCATION SPACE INVENTORY SYSTEM
ROOM DATA SHEET

ESSENTIAL DATA BOX

INSTITUTION: ____________ CAMPUS: ____________ COLLECTION DATE: ____________

BUILDING NO: ____________ BUILDING NAME: ____________ COLLECTED BY: ____________

ROOM NO: ____________ ROOM AREA: ____________ USABLE FLOOR AREA: ____________ CONDITION: ____________

ROOM TYPE: ____________ (PRIMARY) ROOM FUNCTION: ____________ (PRIMARY) ALLOCATION: ____________ (PRIMARY)

NO OF WORKSTATIONS: ____________

ROOM TYPE: ____________ (SECONDARY) ROOM FUNCTION: ____________ (SECONDARY) ALLOCATION: ____________ (SECONDARY)

ROOM NAME: ____________ LEVEL NO: ____________ WING: ____________

REMARKS: ____________

ELEMENTAL No	Code	ELEMENT	
07	WW	**Windows**	
	WWAW	Window Sliding	
	WWAW	Window Hopper	
	WWAW	Window Fixed	
	WWLF	Window Louvre	
	WWFS	Flyscreen	
	WWNE	Other	
11	ND	**Internal Doors**	
12	WF	**WALL FINISHES**	
	WFCB	Concrete Masonry	
		Concrete Masonry, Painted	
	WFFC	Unpainted Concrete	
		Painted Concrete	
	WFPL	Plasterboard	
	WFVY	Vinyl	
	WFAC	Acoustic Panels	
	WFMT	Ceramic/Mosaic Tiles	
	WFNE	Other	
		Skirting PVC	
		Skirting Metal	
		Skirting Duct	
13	FF	**FLOOR FINISHES**	
	FFTF	Concrete	
	FFCP	Carpet	
	FFCP	Carpet Tile	
	FFHD	Heavy Duty	
		Seamless Floor	
	FPVY	Vinyl Sheet	
	FRVY	vinyl Tile	
	FFCT	Ceramic Tile	
	FFFB	Timber	
	FFRV	Rubber	
	FFNE	Other	
14	CF	**CEILING FINISH**	
	CCFB	Suspended Tiles	
	CFTB	Timber Battens	
	CFSL	Sheet Lining	
	CFFV	Proprietary Ceiling	
	CFPL	Plaster	
	CFFF	Painted Concrete	
	CFRF	Rendered & Painted	
	CFFC	Off-Form Concrete	
	CFAC	Acoustic Ceiling - Carpet	
	CFAC	Acoustic Ceiling - Vermiculite	
		Acoustic Ceiling - Hessian	
		Acoustic Ceiling - Fibre	
	CFFC	Unceiled	
	CFNE	Other	
15	FT	**FITMENTS**	
	FTDW	Benches, Cupboard	
	FTCP	Blackboard	
	FTCP	Whiteboard	
	FTDB	Lectern	
	FTGC	Projection Bollard	
	FTND	Pinboard	
	FTMR	Mirror	
	FTSH	Shelf	
	FTCH	Coat Hooks	
	FTNE	Other	
		Paper Towel Holder	
		Soap Dispenser	
		Toilet Roll Holder	
		Towel Rail	

ELEMENTAL No	Code	ELEMENT	
16	SE	**SPECIAL EQUIPMENT**	
	SEAV	Projection Equipment	
	SEAV	A/V Equipment	
	SEAV	Projection Screen	
	SECF	Wall Fan	
	SECF	Ceiling Fan	
	SECF	Floor Fan	
17	SF	**SANITARY FIXTURES**	
	SFCS	Cleaners Sink	
	SFUR	Urinal	
	SFPC	WC	
	SFSH	Shower	
	SFSD	Sink	
	SFWB	Basin	
	SFDF	Drinking Fountain	
	SFNE	Other	
18	PD	**SANITARY PLUMBING**	
	PDPS	Sewer	
	PDTS	Trap	
	PDPA	Neutralising Tank	
	PDFW	Floor Waste	
	PNNE	Other	
19	WS	**WATER SUPPLY**	
	WSAW	Cold Water	
	WSHW	Hot Water	
	WSWO 06	Demin. Water	
	WSCW 02	Chilled Water	
	WSAW 01	Tanks	
	WSSW 08	Distilled Water	
	WSTO 02	Other	
20	GS	**GAS**	
	GSRE	Gas/LPG Reticulated	
21	SH	**SPACE HEATING**	
	SHUH	Unitary Space Heater	
	SHRH	Reticulated Hot Water	
	SHRS	Reticulated Steam	
	SHNE	Other	
22	VE	**VENTILATION**	
	VEDS	Supply Only	
	VEDE	Exhaust Only	
	VEFE	Fume Exhaust	
	VEKE	Kitchen Exhaust	
	VENE	Other	
24	AC	**AIR CONDITIONING**	
	ACSZ	Single Zone	
	ACMZ	Multizone	
	ACVV	Variable Volume	
	ACFC	Fan Coil Unit	
25	FP	**FIRE PROTECTION**	
	FPHS	Fire Hose Reel	
	FPHS	Fire Hydrant	
	FPFD01	Thermal Alarms	
	FPFD02	Smoke Detectors	
	FPMA	Break Glass Alarm	
	FPEO	Hand Extinguisher	
	FPNE	Other	

ELEMENTAL No.	Code	ELEMENT	
26	LP	**LIGHT & POWER**	
	LPPO02	Single Phase Power	
	LPPO04	Multiphase Power	
	LPEL	Emergency/Exit Lights	
	LPLIS	Lighting	
	LPNE	Other	
27	CM	**COMMUNICATIONS**	
	CMCB	Clock	
	CMTA	Telephones	
	CMTP	Intercoms	
	CMPA	PA	
	CMTV	Antenna TV	
	CMCV	CCTV	
	CMEW	Evacuation Alarm	
	CMNG	Other	
		Data	
28	TS	**TRANSPORTATION SYSTEMS**	
	TSMH	Hoist	
	TSSL	Dumb Waiter	
29	SS	**SPECIAL SERVICES**	
	SSCA	Compressed Air	
	SSVS	Vacuum	
	SSMO	Oxygen	
	SSCR	Special Conditioned Room	

EQUIPMENT	
Compressor	
Vacuum Pump	
Autoclave	
Pump	

HIGHER EDUCATION SPACE INVENTORY SYSTEM

BUILDING DATA SHEET

ESSENTIAL DATA BOX

INSTITUTION: ____________ CAMPUS: ____________ COLLECTION DATE: ____________

BUILDING NO: ____________ BUILDING NAME: ____________ COLLECTED BY: ____________

GROSS FLOOR AREA (GFA): ____________ sqm

USABLE FLOOR AREA (UFA): ____________ sqm

AREA EFFICIENCY: ____________ %

BUILDING CONDITION: ____________

ORIGINAL CONSTRUCTION DATE: ____________

ORIGINAL CONSTRUCTION COST: $ ____________

CURRENT REPLACEMENT VALUE: $ ____________

OWNERSHIP:

OWNED & USED ☐

NOT OWNED BUT USED ☐

OWNED BUT NOT USED ☐

FUNDING SOURCES: %

GOVERNMENT

INSTITUTION

PRIVATE

OTHER

CONSTRUCTION TYPE	
Framed	
Load Bearing	

DISABLED ACCESS	
Good	
Marginal	
Impossible	

05	RF	ROOF	
	RFCC	Concrete Roof	
		Fabric Roof	
		Metal Roof	
		Tile Roof	
		Other	

STAGING DETAILS			
	ufa	gfa	date completed
Stage 1			
Stage 2			
Stage 3			

06	RW	EXTERNAL WALLS	
	EWBW	Brick	
	EWCB	Block	
	EWSC	In-situ Concrete	
	EWPC	Precast Concrete	
	EWTF	Timber Framed	
	EWSD	Sheet Cladding	
	EWNE	Other	

MAJOR RENOVATIONS

Date Completed: ____________

Date Completed: ____________

21	SH	Space Heating	
24	AC	Air Conditioning	
28	TSPL	Passenger Lifts	

FUNCTIONAL SPACE INDICATORS

SPACE INDICATOR GROUP	INDICATIVE SPACE FOR STAFF FUNCTIONS SQM PER EFT STAFF								INDICATIVE SPACE FOR SPECIALISED AREAS SQM /EFTSU			
	TEACHING ONLY	RESEARCH ONLY		TEACHING & RESEARCH		OTHER FUNCTION	OTHER FUNCTION	ALLOWANCE FOR ANCILLARIES (%)	OTHER THAN HIGHER DEGREE	HIGHER DEGREE BY COURSEWORK	HIGHER DEGREE BY RESEARCH	ALLOWANCE FOR ANCILLARIES (%)
(Notes)	OFFICE (1)	OFFICE (1)	LAB (2)	OFFICE (1)	LAB (2)	CLASSIFICATION 01 -06, 08, 09 (3)	CLASSIFICATION 07,10 (4)	(5)	(6)	(7)	(8)	(9)
A	14	0	16	14	16	12	6	10	4	5	10	60
B	14	7	16	14	16	12	6	10	4	5	7	40
C	14	14	0	14	0	12	6	10	0	0	7	20
D	14	14	0	14	0	12	6	10	4	5	7	40
E	14	0	16	14	16	12	6	10	4	5	10	30
F	14	0	16	14	16	12	6	10	4	5	10	50
G	14	14	0	14	0	12	6	20	0	0	0	0

N.B. Space Indicator Group G is used for all staff other than those employed within Academic Organisational Units.

OTHER AREAS

LIBRARY including Departmental Libraries

Reader Places		
	1 place @ 2.75sqm / 5 eftsu	0.55 sqm / eftsu
	(includes .05 sqm / eftsu for flexibility)	
	extra allowance per law eftsu	0.8 sqm / eftsu
Bookstack	open stack	6 sqm /1000 vol
	closed stack	3 sqm /1000 vol
Reserve collections	basic provision	50 sqm
	additional	17.5 sqm/1000vol
Special collections		Ad hoc
Bulk Store	(justify)	Ad hoc
Other	(justify)	Ad hoc

COMMON TEACHING AREAS

including all seminar rooms, lecture theatres	1 sqm / eftsu
Computing Laboratories	3.5 sqm / eftsu

AUDIOVISUAL SECTION	500 sqm

ADDITIONAL AREAS

Additional areas for the following will be considered on an individually justified basis.

. Student / staff services
. Residentials
. Main Frame Computer Rooms
. General storage and Archives
. Sporting Facilities for Physical Education

HIGHER EDUCATION SPACE INDICATORS FOR DISCIPLINE GROUPS

DISCIPLINE	DEET CODE	SPACE GROUP	SPECIAL PROVISIONS
HUMANITIES	**01.00**		
English	01.01	C	
History	01.02	C	
Philosophy	01.03	C	
Ethnic/Area studies	01.04	C	
Languages o/t English	01.05	F	Includes provision for Language Laboratories
Communication Studies	01.06	C	
Religious Studies	01.07	C	
Other Humanities	01.99	C	
SOCIAL STUDIES	**02.00**		
Behavioural Sciences	02.01	A	
Geography	02.02	B	
Library/ Archival Studies	02.03	C	
Welfare, Counselling	02.04	F	
Sport, Recreation	02.05	C	
Political Science, Government	02.06	C	Provide additional space for Computing Laboratories
Sociology	02.07	C	Provide additional space for Computing Laboratories
Other Social Studies	02.99	C	Provide additional space for Computing Laboratories
EDUCATION	**03.00**		Provision is made for subject matter studies eg Maths, Sciences, Phys Ed, Drama to be classified in categories other than Education
Education Studies	03.01	C	
Teaching Practice	03.02	D	
SCIENCES	**04.00**		
Biological Sciences	04.01	A	Includes Animal Houses
Earth Sciences	04.02	F	Provide additional ad hoc space for rock collections
Physical/Material Sciences	04.03	F	Provide additional ad hoc space for Equipment Dominated Areas
Pharmacology	04.04	A	
Chemical Sciences	04.05	F	Provide additional ad hoc space for Equipment Dominated Areas
Other Sciences	04.99	E	

HIGHER EDUCATION SPACE INDICATORS FOR DISCIPLINE GROUPS

DISCIPLINE	DEET CODE	SPACE GROUP	
MATHEMATICS, COMPUTING	**05.00**		
Mathematics, Statistics	05.01	E	
Computer-based Information Systems	05.02	E	
Computer Science	05.03	E	
Other Mathematics, Computing	05.99	E	
VISUAL/PERFORMING ARTS	**06.00**		
Art	06.01	D	
Graphic Arts/Fashion Design	06.02	D	
Craft,Ornaments	06.03	D	
Performing Arts	06.04	D	
Music	06.05	D	
Other Visual,Performing Arts	06.99	D	
ENGINEERING, PROCESSING	**07.00**		
Chemical	07.01	E	Provide additional ad hoc space for Equipment Dominated Areas
Civil,Structural	07.02	E	Provide additional ad hoc space for Equipment Dominated Areas
Electrical,Electronic, Computer, Communications	07.03	E	Provide additional ad hoc space for Equipment Dominated Areas
Mechanical,Automotive Aeronautical	07.04	E	Provide additional ad hoc space for Equipment Dominated Areas
Mining	07.05	E	Provide additional ad hoc space for Equipment Dominated Areas
Industrial,Processing	07.06	E	Provide additional ad hoc space for Equipment Dominated Areas
General Engineering	07.89	E	Provide additional ad hoc space for Equipment Dominated Areas
Other Engineering, Processing	07.99	E	Provide additional ad hoc space for Equipment Dominated Areas

HIGHER EDUCATION SPACE INDICATORS FOR DISCIPLINE GROUPS

DISCIPLINE	DEET CODE	SPACE GROUP	
HEALTH SCIENCES	**08.00**		
Medical Technology	08.01	A	
Therapies, Therapeutic Technology	08.02	A	
Nursing	08.03	A	
Nutrition, Dietetics	08.04	A	
Environmental Health	08.04		
Medicine, Medical Science	08.06	A	
Dentistry, Dental Science	08.07	A	
Optometry, Optical Technology	08.08	A	
Community/Family/ Personal Health Care	08.09	A	
Other Health Sciences	08.99	A	
ADMINISTRATION, BUSINESS, ECONOMICS LAW	**09.00**		
Economics	09.01	C	Provide additional space for Computing Laboratories
Accounting	09.02	C	Provide additional space for Computing Laboratories
Commerce, Sales, Service	09.03	C	Provide additional space for Computing Laboratories
Management, Administration	09.04	F	
Secretarial Studies	09.05	C	Provide additional space for Computing Laboratories
Law, Justice, Legal Studies	09.06	C	Provide additional space for Computing Laboratories
Other Administation, Business, Economics, Law	09.99	C	

HIGHER EDUCATION SPACE INDICATORS FOR DISCIPLINE GROUPS

DISCIPLINE	DEET CODE	SPACE GROUP
BUILT ENVIRONMENT	**10.00**	
Architecture	10.01	D
Environmental/Product Design	10.02	D
Building Construction	10.03	D
Surveying	10.04	E
Other Built Environment	10.99	D
AGRICULTURE, RENEWABLE RESOURCES	**11.00**	
Agriculture	11.01	A
Animal Husbandry	11.02	A
Forestry, Parks, Wildlife	11.03	A
Veterinary Science	11.04	A
Other Agriculture, Renewable Resources	11.99	A

INDICATIVE SPACE FOR THE INSTITUTION CALCULATED FROM STAFF &STUDENT DATA SETS & SPACE INDICATOR GROUPS

TOTAL INSTITUTIONAL NEEDS		INDICATIVE SPACE FOR STAFF FUNCTIONS (SQM)								INDICATIVE SPACE FOR SPECIALISED AREAS (SQM)					SUB-TOTAL	LIBRARY SPECIAL SPACE from table below	COMMON TEACHING AREA	COMPUTING LABS	GRAND TOTAL
SERIAL	ORGANISATIONAL UNITS	TEACHING ONLY	RESEARCH ONLY		TEACHING & RESEARCH		OTHER FUNCTION	OTHER FUNCTION	ALLOWANCE FOR ANCILLARIES (%)	OTHER THAN HIGHER DEGREE	HIGHER DEGREE BY COURSEWORK	HIGHER DEGREE BY RESEARCH	EQUIPMENT DOMINATED AREA (JUSTIFY)	ALLOWANCE FOR ANCILLARIES (%)					
		OFFICE	OFFICE	LAB	OFFICE	LAB	CLASSIFICATION 01 -06, 08, 09	CLASSIFICATION 07,10											
1.1	Faculty 1																		
1.2	Faculty 2																		
1.3	Faculty 3																		
1.4	etc																		
1.5	Library																		
1.6	Administration																		
1.7	Buildings & Grounds																		
1.8	etc																		
1.9	etc																		
1.10	etc																		
	INSTITUTION TOTAL																		

This table is indicative of the form of output of a Report of the Indicative Space Needs of the Total Institution.
Similar reports would be produced by DEET for each institution.
The Report would have two versions: Present Space Needs derived from statistical data, and Future Space Needs, established in the Planning Mode of the SPAM System.

LIBRARY SPECIAL SPACE

Reader Space	
Open Stack	
Closed Stack	
Reserve Collections	
Other (Justify)	
Total Library Special Space	

Smith

Swistock

The Design-Build Team: A Success Story

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University of Virginia

Physical Plant is a large, diverse service organization with a constituency that includes almost every segment of the campus community. One of the major services provided by Physical Plant is the management of minor construction and renovations of facilities to meet the changing needs of the various schools, departments, and organizations.

Renovations and minor construction can be accomplished by commercial construction firms as well as Physical Plant forces. Contractor forces are a valuable resource that Physical Plant managers should consider and use when appropriate to meet the construction requirements of the University.

Physical Plant forces, however, should be more responsive, need less specific direction and plans, and be more accommodating to user constraints such as working in occupied spaces, than commercial contractors. This paper will outline a process developed and used at the University of Virginia to evaluate smaller construction and renovation projects, and when it is appropriate to accomplish them in-house, details the process that assures the most effective management of the project. The system preserves the established priority system and provides for adequate reviews to assure code, architectural and other requirements are met.

The University has in place a system to provide requestors (customers) a Project Investigation Report (PIR), and a system to accomplish approved work on a cost-reimbursable basis or on a fixed price contracted basis. This system provides for site investigation, coordination with customers, preliminary design and cost estimates, final design, and cost estimates, and then construction. At each step, customer approval is required before proceeding to assure that the project will meet customer requirements and fund availability. This is very similar to the process normally used between an architect/engineer and owners to develop any project. Because of the necessary approvals at each step, project development for small jobs will often require more time for project development than construction.

The fast-track method of project development and management allows several of the traditional steps in project development to occur simultaneously. At the University of Virginia, the fast-track method also provides for various cost options including cost reimbursable, fixed price, and a guaranteed maximum price (GMP).

The GMP estimate is developed very early in project development, well before formal plans and specifications are prepared. The estimate is based on cost-history for similar projects or on other estimating techniques used by estimators and work center supervisors, and is tempered with known or anticipated site construction conditions. When the customer accepts the GMP, estimating and project design, material procurement and site preparations may start simultaneously, shortening the total project completion time significantly.

A three percent surcharge is included in the GMP. This three percent charge is accumulated in a fund to cover, if necessary, any overruns on this or other GMP projects. If an overrun occurs and adequate funds have not been accumulated to cover it, additional costs are borne by the overhead accounts of the managers involved. If excess funds are accumulated from the three percent surcharge, they are periodically distributed to each involved manager's overhead. This provides a real incentive to the Physical Plant managers involved in the project to assure that work is completed within the GMP.

Customers who have funds for a project but have been frustrated with the time required to proceed through sequential steps of a traditional project development are very happy with the system. Customers also like the GMP element of the system as it limits financial exposure early in project development and allows, and encourages cost savings initiatives during project design and construction. This has resulted in a closer coordination and working relationship between customers and physical plant project managers than is traditionally experienced. The involvement of work center supervisors in preparation of GMP estimates and project management leads to a strong commitment to the whole project by all physical plant people involved.

A typical project request entering the Physical Plant will go through a process designed to expedite the handling of **every** project. For purposes of this paper, emphasis will be given to those projects deemed to be appropriate for the **Design-build** approach.

Upon entering the Physical Plant system, all work requests are reviewed by a **Project Review Team**. The Team makes initial judgments such as the potential for Design-build, which area of Physical Plant will have primary responsibility for management of the work request, and whether any construction for the work request will be performed by in-house forces or by outside contract.

The **Project Review Team**, composed of representatives of Architectural and Engineering Services Department, Operations Department, and Work Management Division, also recommends the pricing method to be used; Guaranteed Maximum Price (**GMP**), Fixed Price, or Cost Reimbursable. When a work request appears to be suitable for the Design-build process, a **Design-Build Team (Team)** is formed by the Project Manager.

For most projects at the University, the **Team** has the following composition:

The **Designer** is represented by the in-house **Design Group** of the Engineering and Design Services Division, supported by in-house engineering. In some instances, outside engineering consultants are used to support the Design Group.

The **Contractor (or Builder)** is represented by the in-house construction forces of Physical Plant, which is the **Renovations Division**.

The **Team** is supported by **Planner/Estimators** from the Work Management Division. The Planner/Estimators perform quantity take-offs and labor estimates based on job history and personal experience with similar work.

The **Team** has the responsibility for meeting with the requestor to determine the scope of work and the content of the design program. Once this has been done, the **Project Budget Process** begins. An **initial budget** proposal is developed using square foot values based on recent construction of similar facilities. This proposal includes an outline specification, following the CSI format, which delineates the basic scope of work, finishes and fixtures proposed. Based on the **initial budget**, a decision is made as to the pricing method to be **offered** to the requestor. This normally would be a **GMP** unless the scope of work is too vague, or the requestor prefers a fixed price. This decision is always based on the **unanimous** agreement of all members of the **Team**.

The **Team** then makes the proposal to the requestor, who must accept the proposal, and authorize funds to be expended on the project prior to any additional work on the project. At this point, essentially all remaining decision-making resides in the **Team**. The centralization of the decision-making process is a major factor in expediting a project. From this point on, a number of the project functions can proceed concurrently, rather than consecutively as in conventional project planning.

Some typical concurrent planning functions are:

a. The **refined project budget** and the **design documents** can be developed concurrently. As the budget is refined, it may be possible to provide the requestor with an updated, and **lower GMP**. This is highly recommended, as it gives the requestor confidence, and improves credibility in the **Design-build** process.

b. As **preliminary design** establishes a floor plan, **demolition** may start.

c. **Layout** and **Long Lead Item ordering** may be started when **Final Design** is started.

If appropriate, a **Final GMP** may be offered the requestor after all design decisions have been made, and quantity take-offs are completed and priced. The GMP must be realistic, not just a "cover all bases, safe" estimate. It is important to build requestor credibility in the process. Having a GMP that will relate well with actual costs is one way of achieving this.

The University of Virginia currently has six (6) projects, ranging from a renovation of a laboratory in the

Health Sciences Center to renovation of an entire child care facility. Other facilities have been completed, and ten (10) projects are now being evaluated by the **Project Review Team** to determine the appropriateness of including these projects in the **Design-build** process. A number of factors will determine this:

a. The current workload in the Physical Plant areas that will support the project. It is essential that this item be carefully documented and evaluated. This is the reason the University has representatives of the key functions serving on the **Project Review Team.**

b. The requestor's willingness to commit funds to the project based on preliminary pricing information. Once a scope is determined and agreed upon, it is essential that funding be available to allow the project to move forward without delays due to funding holds.

c. The availability of the space proposed for the work. The space must be accessible in a timely manner. The reason the **Design-build** process is an attractive approach for Physical Plant is that it provides better control of project flow and scheduling. This enhances the ability of Physical Plant to effectively use its resources.

Delays due to spaces proposed for renovation being occupied, or otherwise not available, are beyond the control of Physical Plant forces. This also adversely impacts the effective management of Physical Plant resources.

d. The amount of design effort required. If a project requires significant study and design in order to develop the scope, it may not be appropriate for the **Design-build** approach.

Normally, the **Design Process** begins with **preliminary design** which includes a floor plan with conceptual mechanical and electrical systems, and a basic finish schedule. These serve to communicate the proposed scope of work to the **Team** and the customer. With any mid-course corrections incorporated, **final design** starts. This includes **only** the basic plans, sections, specifications, and details only as deemed necessary by the contractor (renovation division). The **Team** develops the final **GMP** from these **final design** documents.

The **construction process** takes maximum advantage of the skills, experience and expertise of the work force. Each trade **knows** what is required. Essentially, only basic plans and specifications are needed to guide these building professionals as they transform spaces into places. Also, the meaningful involvement of the trades in the "creation" of the finished product has the benefit of building job satisfaction, pride of accomplishment and increases interest in service excellence.

The University of Virginia, with experience ranging from research laboratory renovation to renovation of unfinished space into an executive office suite, has found the **design-build** approach advantageous to customers **and** to Physical Plant. This process allows Physical Plant to be more responsive to the needs of the customer. It provides better control of the work flow in Physical Plant, enhancing the effectiveness of Physical Plant resources. And, it provides the customer the best possible space at the least possible cost in the least possible time.

Now, that is success!

Special Considerations in Designing a Research Building

Daniel Carl Johnson
Project Manager, Major Construction
Penn State University

This morning I would like to take the opportunity to introduce myself and to explain how the University accomplished the designing and construction of what we called a Surge Research Building. As the program indicated, I am Daniel Carl Johnson, a Project Manager in major construction for The Pennsylvania State University. Before we get into the meat of my presentation for the University's Surge Building, while I was putting some notes together a good news/bad news story came to mind. I felt I should spend a minute and share the story with you. The story goes something like this--now you must use your imagination to visualize that you are standing in the galley of the Queen's slave ship on the Nile River in Egypt. You are looking down on the slaves that are chained to the oars. Then enters the slaves' master who drums the cadence which sets the speed of the barge. He announces that he has good news and bad news. He asks which the slaves would like to hear first. One of the smaller slaves, who was chained to the oar, gets excited and yells, "Let's have the good news first, let's have the good news first!" So the slave master says, "Well the good news is this: Today for breakfast we are going to serve you hot cereal, ham and eggs, sausage, home fried potatoes, hot coffee, and jelly and jam for your well-buttered toast." And the slaves go crazy. They are happy and jumping up and down and hooraying this and hooraying that and all at once the same little slave in the back of the galley says, "Wait a minute, wait a minute, what is the bad news?" The slave master looked at them and said, "The bad news is that the Queen wants to go water skiing."

This is how I felt many times during the design of new building projects. Many times you hear the good news and other times you hear the bad.

Over the 23 years of working with the University, I have worked on the design and construction of many types of buildings that are designed to be used for research and teaching, particularly laboratories within buildings that are intended for use by one discipline only. But until this time, I had not worked on a building that was not primarily designed for a specific teaching or research need. We have designed laboratory buildings for housing Biotechnology specifically. We have also designed laboratories for Biology, Chemistry and Physics; electrical laboratories; and computer laboratories--but this was the first time that we had been asked to design a new building specifically called a Surge Research Building.

The dictionary defines the word surge as "a swelling, rolling or sweeping forward like that of a wave." This was the position that the University felt they were in relative to research lab space. The Vice President for Research and Dean of the Graduate School said "Penn State has experienced a tremendous surge in private industrial-sponsored research and development projects and now requires a facility to help answer the need." With that statement, the University administration was approached, and they agreed that there was a need; they backed the project, calling it the "New Surge Research Building."

What I would like to do is to take you on a step-by-step overview of the many events that took place over an approximately three-year period that it took to produce the building. It all started when the University first requested the Office of Physical Plant to proceed with the hiring of the professional.

With this direction, in February of 1986, we hired the architect to perform a feasibility study for the project. What we felt we needed was for the study to give us a more defined and disciplined program, more than what we had been saying to date in a broadbrush way. We knew we needed a building which would house flexible multidiscipline laboratories and whatever support services they would require, but we wanted to know if it could be built on the fixed budget that was presented and if it could be sited as we had suggested. We also needed to know to what extent the utilities would have to be extended.

The report from the study produced some positive and, of course, some negative answers to many of our questions. The positive answers outweighed the negative ones, and we proceeded to hire the architect and his engineering team to proceed with the design, bid and construction of the building.

The first approach that we made to the design phase was to appropriately site the building. The site that we had suggested presented two concerns: One, we had to architecturally design a building that would be a strong statement for the east side of campus, which is approached from a major highway, Route 26. Two, one of the building requirements was to produce a building that would work well with the existing Academic Projects Building with a requirement to tie the buildings together. This would answer a severe problem of architectural barrier that existed in the Academic Projects Building. The existing building was built prior to codes for handicapped design.

I think we answered both of them very well. Again, as I pointed out, the engineers occupying the building felt strongly enough about the architectural appearance of the building to feature it on their brochure of specific engineering research. Additionally, the tie-in by a second-story bridge and a connecting corridor in the basement to the existing building permits us to have the handicapped entering the building through the new building without any architectural barrier. The elevator in the new building permits the handicapped to have accessibility to the upper and lower floors in the existing building.

We had planned to bid the project in September of 1988 and allow 12 months to construct. We missed the September bid date by three months and took bids in December of 1988. This concerned us, starting excavation at this time of the year, but the contractors extended themselves and we completed in December of 1989.

The design of any building, I feel, is influenced by the budget. We had a fixed budget and it was determined as we progressed into the sketch stage that the program was more than the budget would allow, which I am sure many of you have witnessed with your building designs. Our budget at that time was $5,000,000 for construction.

The fixed budget is just what it is said to be--fixed. I confronted the committee with the following: either compromise our program by reducing it, or investigate to determine if the administration would commit additional dollars to the project. As events turned out, we did both. We had $500,000 additional dollars added to our budget, and we also compromised the program in certain areas of size and design.

We reduced the size of the laboratory space and agreed on a size of 24' x 31', which is approximately 775 square feet. The office size was reduced to 9' x 14' for 126 square feet. The offices are planned as one-person offices. We omitted the suspended ceiling in the labs and corridors. We found that omitting the ceilings in these areas had been well accepted at other University facilities.

It was determined that the best approach to designing a flexible multidiscipline laboratory space would be to not design a specific laboratory layout. At this stage of the project, we did not know who the clients were or what they would require or need in a lab layout. The committee conducted a survey of the various deans and research persons throughout the University in the different disciplines of engineering and sciences and came back to us with, as you can imagine, multifaceted and very pointed needs if a particular person or group were to occupy one of the laboratories within the building.

The more we investigated and the more we evaluated, the more it led us to believe that the best approach to creating flexible space was to not equip it with lab furniture and equipment. It was determined that the best approach would be to design the laboratory spaces in a modular fashion with the offices adjacent to that space. It was also determined that all laboratory utilities would be made available to each laboratory, and provisions to add fume hoods would be built into the project. We also recognized that the general purpose research space that we were creating would fit the needs of some disciplines well and some others not so well.

Our intention was that when researchers received grants for specific projects, they would arrange to occupy lab space or spaces and would be required through their grant monies to purchase lab furniture and equipment to lay out their laboratories as they needed them.

This was the avenue of design that we followed: The first floor was designed with 8 laboratories and 16 offices. It also had storage rooms and conference space. The second was designed as a loft space.

The basement was also designed as unfinished space. The design gave us the capability of finishing the second floor and basement area at a future date. We did encounter some setbacks in our design as we progressed. The adjoining building had an underground storage area for radiation waste, which was not very comforting as a potential next-door neighbor. We had to include certain safety factors to keep the isolation of the radioactive materials at bay, as you might expect. That was accomplished with some lead lining and extension of the exhaust for that space through the new building to the roof.

The mechanical design required a mechanical room in the basement and a penthouse, which housed the equipment for the HVAC systems. We had created a very large and deep trough running horizontally with the long dimension of the building, approximately 8 feet deep by some 16 feet wide. This was created to hide the roof-mounted mechanical equipment. As it turned out during the construction stage, the equipment and stacks still showed above the roofline of the building. It was painted to match the metal roof color. I will point this out when I show you the slides of the building.

The requirements of the University for all buildings also included the need for all offices to receive telecommunications outlets for telephone and data connections. This is a standard which was adopted in this building, and we believe it to be monies well spent during construction in lieu of retrofitting later.

In order to give us the most flexible lab space possible, the building design called for the laboratories to be divided by a service corridor which runs the long dimension of the building. This service corridor eliminated the need for pipe and duct chases running to each lab area. Pipes and ducts are extended vertically in a large chase and taken horizontally to the service corridor. Then from the service corridor, we extended all utilities into laboratories, valving and capping them off in the labs. Floor drains were included in the lab spaces. When the first client occupied the building, he recognized the need for additional floor drains. The building contractors were still working on punch list items and we added the additional drains by change order.

Our building was classified under Labor and Industries Fire & Panic Regulations as a "D.O. Ordinary Occupancy." This classification was based on our building's being four stories or less. Our building was built with noncombustible construction, so fireproofing of steel was not required.

Fire protection was answered by installing a sprinkler system throughout the building. A dry standpipe system was installed in the stairwells. We have stopped using fire hoses and cabinets in our buildings. We found that the hoses tend to grow old and when used show fatigue and are not reliable.

Our client was concerned about vibration in the building and requested that we design the building to answer this concern. We increased the concrete slab thickness from 4 1/2" to 5 1/2". The slab was designed for a 175-pound loading.

This building, as in all our buildings at the University, is designed for insulation values of R-30 at the roof and R-20 at the walls. We adopted these values during the energy crunch and have found them very rewarding in our HVAC operating costs.

As you will see as we review the slides of the building, we did provide the following miscellaneous facilities: janitor closets and janitorial storage room, and telephone and electrical closets on each floor. Also provided are conference rooms, building storage rooms and toilet facilities on each floor.

All laboratories and offices have year-round air conditioning with humidity control. This is accomplished by variable air volume boxes and terminal reheat coils. For economics, a maximum of three offices are controlled from a common variable volume box. Each laboratory has individual temperature control.

For reliability, dual air-conditioning chillers have been installed. For economics of operations, each chiller is capable of providing approximately two-thirds of the maximum anticipated building cooling load. Exhaust ducts penetrating the roof are protected by a weatherproof box installed on the roof. Supports for the hood exhaust fans are installed adjacent to the weatherproof boxes.

Air; gas; hot, cold and distilled water are provided into each lab from the service corridor. A 100-gallon-per-hour still, with a 1,000-gallon storage tank, provides distilled water. Compressed air, from the campus central plant, is filtered and dried prior to distribution throughout the building.

Laboratory waste and vent piping is acid-resistant polyethylene with mechanical pipe joint. These mechanical joints allow for easy alterations to the waste piping. Additional connections to the waste piping system are provided below each lab floor. Capped floor openings are provided for access to the waste piping from lab equipment.

Because of the large number of video display terminals anticipated, and their associated glare and eye strain, three-tube, deep-cell parabolic lighting fixtures have been installed throughout the labs and offices.

Dual switching has been provided at each lab and office. One switch controls the outer fixture tubes, the second switch controls the inner tube. This switching arrangement provides for three light levels.

A power bus duct in the service corridor provides three-phase power to each lab. Each laboratory has a 100-amp, 3-phase, 208/120-volt panel for laboratory power. Electrical wiring trough extensions have been installed on each side of the panel to facilitate easy connections to laboratory equipment. Power is available at the end of each service corridor in the form of 480 volts and can be easily extended into any lab. A dual-compartment continuous raceway containing data and 120-volt power has been installed on each laboratory wall.

Each lab and office has two voice/data outlets that allow personal computers to communicate with each other or with any other computer on the University's statewide network. The laboratories have provisions for adding additional outlets. An extensive cable tray allows for easy routing of data cable between the labs and offices.

When we bid the project, it was welcomed news to see that the bid was under the fixed budget. The size of the building design was approximately 60,000± gross square feet. The total project costs, which included design and other associated costs as well as the construction costs, amounted to $6,198,000, or about $103.30 per gross square foot.

Now you must recognize that this cost is strictly for the building itself. It did not include any lab equipment. The building was ready to be occupied--it was painted, floor tile installed, things of that nature were included--but as I pointed out, it did not include the lab equipment or fume hoods. We found later, after working with lab equipment suppliers, that a lab equipped with fume hoods and lab furniture would be in the range of $80,000 to $90,000 per lab. As I explained earlier, any research group moving into the building would supply and install their lab equipment as required for their research.

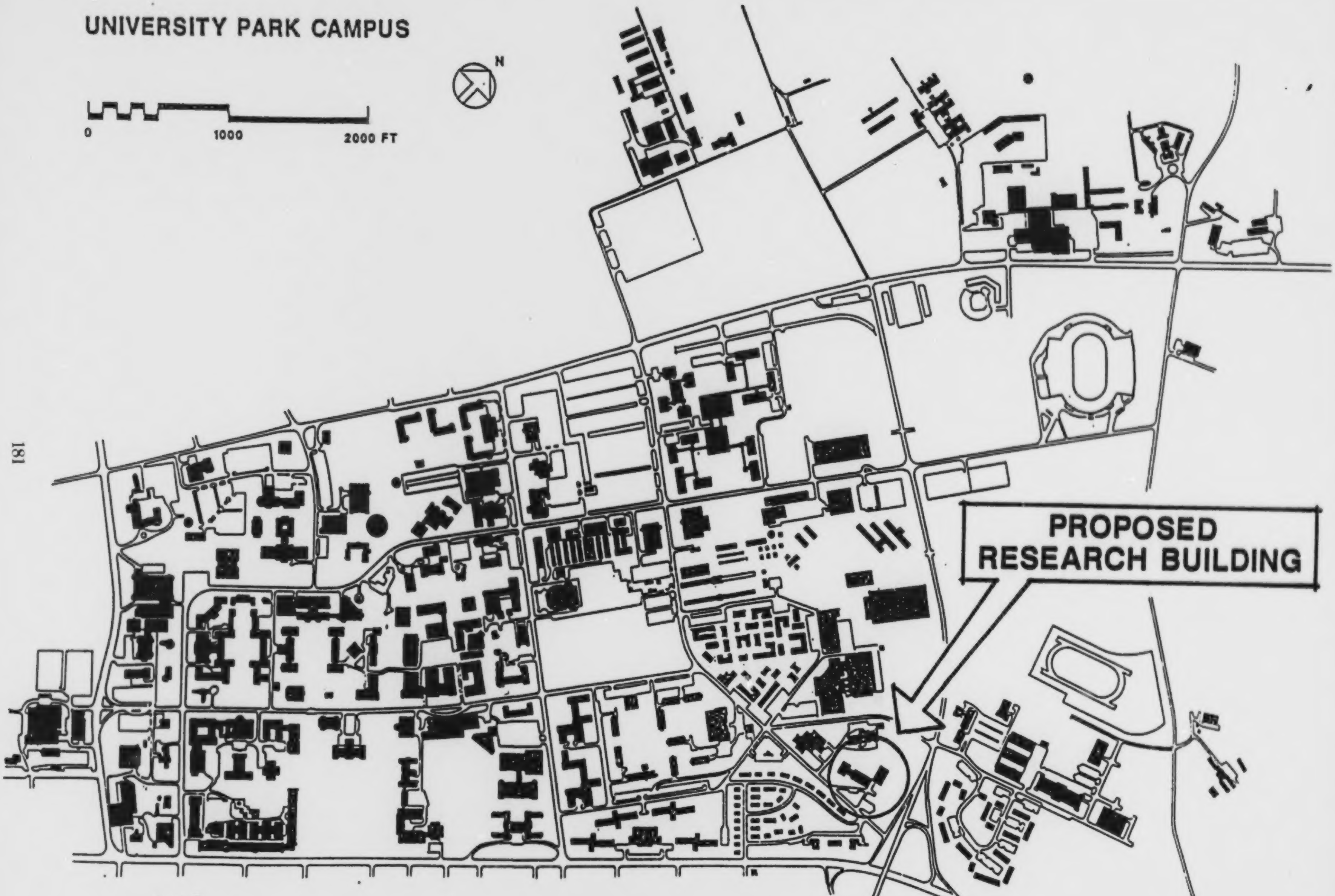
Approximately three-quarters of the way into our construction phase, it was requested by the client to incorporate into the building some of the planned future additions. They requested that the second floor be finished to mirror-image the first floor, and that we prepare the unfinished spaces of the basement to receive laboratories by adding building finishes, concrete floor slab, floor drains and utility extensions. This meant we had to provide supplemental drawings and request prices from the contractors. The project, by the way, was awarded under separate contracts. We had four prime contractors: the general contractor, HVAC contractor, plumbing contractor, and electrical contractor. When we received the costs for the added work from the responsible contractors, it was pleasant again to realize that what we had budgeted and estimated for this work would cover it with some additional dollars to spare. This being the case, as you would expect, the client found other things that were needed in the building. We spent all the dollars that were given to us by the administration to further complete the building, although we still did not install any lab equipment.

We then had a building that included 16 laboratories and 48 offices. The offices were separated from the laboratories by a public corridor. Loading all the offices on the exterior wall side of the corridor permitted us to give all offices a window. I found through years of working with varied persons at the University that the first thing requested when an office is needed is that it must have a window. As we all know, that becomes somewhat of an impossible chore in many buildings, but in this case, we were able to answer that very nicely. So, we wound up with offices on the periphery of the building and all the laboratories as internal spaces. It helped the lab space because it gave us four walls on which to mount equipment. As I mentioned earlier, the laboratories did not abut each other back-to-back; they were separated by the service corridor. This permitted us the opportunity to service the laboratories in two directions from the service corridor. Again, I will be more specific, and point this out, when I show you the slides.

I feel the project was very successful. It did answer our major concerns for the need for a generic-type, flexible, multipurpose laboratory and its support facilities. It in turn is a fine architectural statement for this side of campus and works extremely well in tying the new building to the existing Academic Projects Building. Sometime in the near future, I hope that the administration will permit us to improve the appearance of the existing building. The building has been well accepted by the University and the research users.

Now, let's take a minute and review some slides which represent the drawings that we presented to our Board of Trustees. We use 35mm slides for presentations to our Board of Trustees, first at the sketch/preliminary stage and then updated and presented again at the final stage. The University's Board of Trustees approves all major building project plans and grants us permission to bid and award the project based on the budgeted amount that they have approved for the project. Now, if I can turn out the lights, we'll go into the slides.

Following the slides, I will attempt to answer any questions that you may have.



UNIVERSITY PARK CAMPUS

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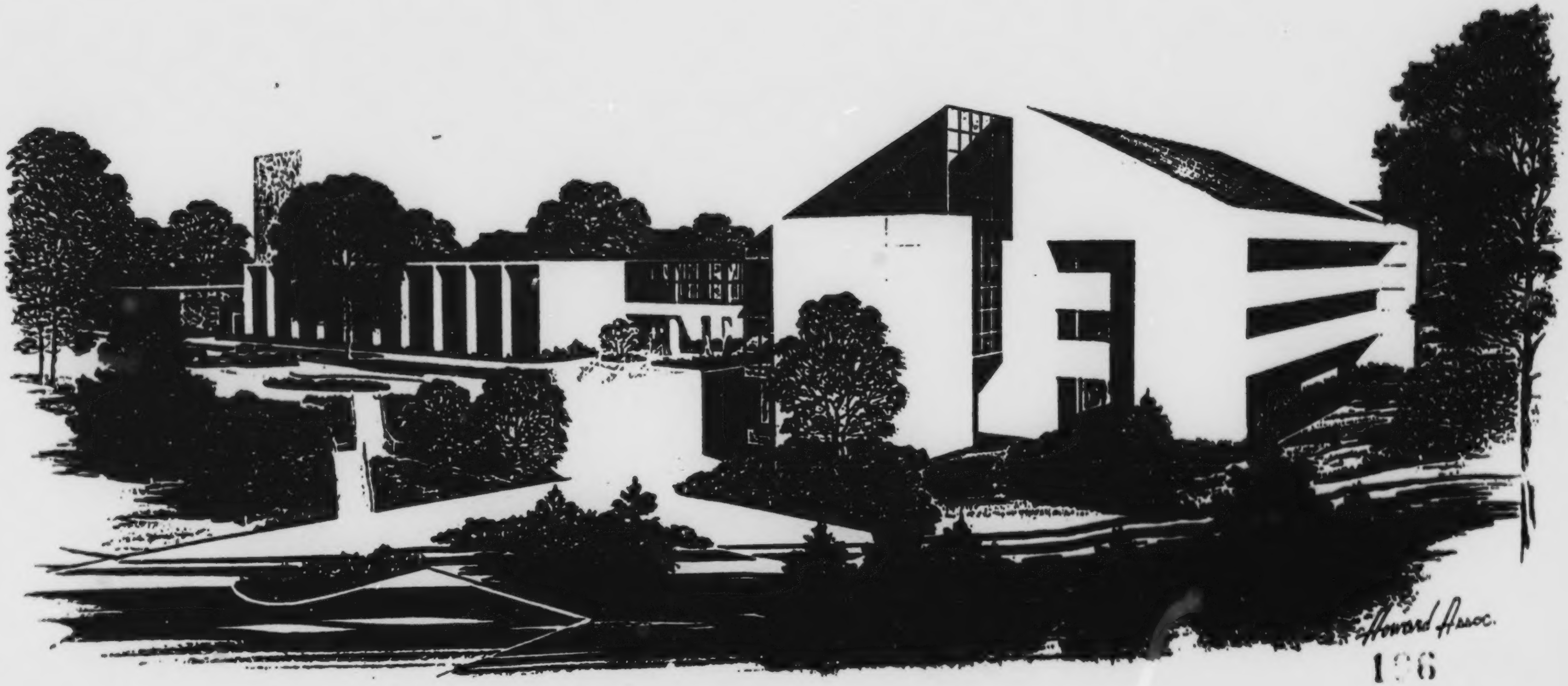
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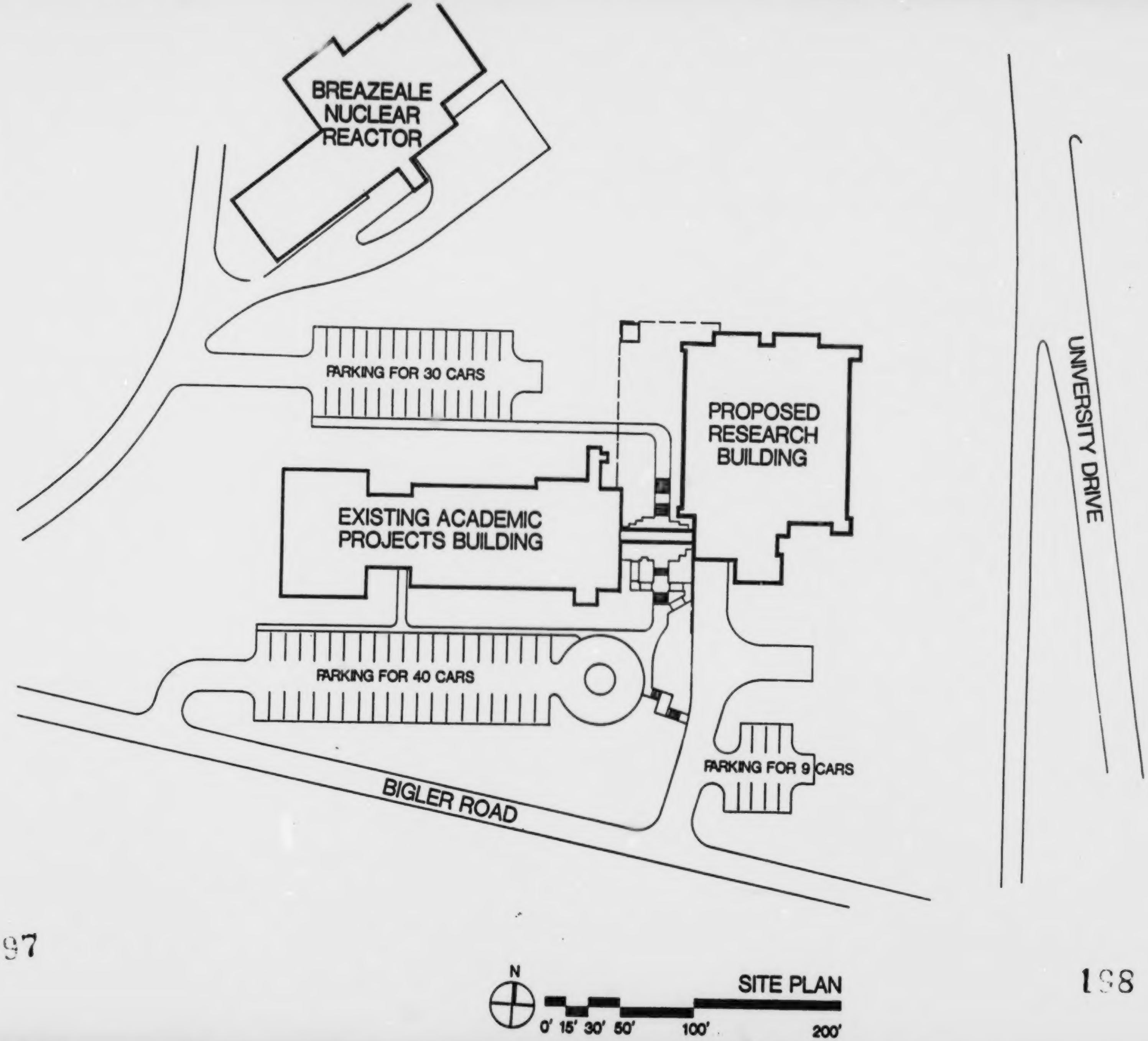
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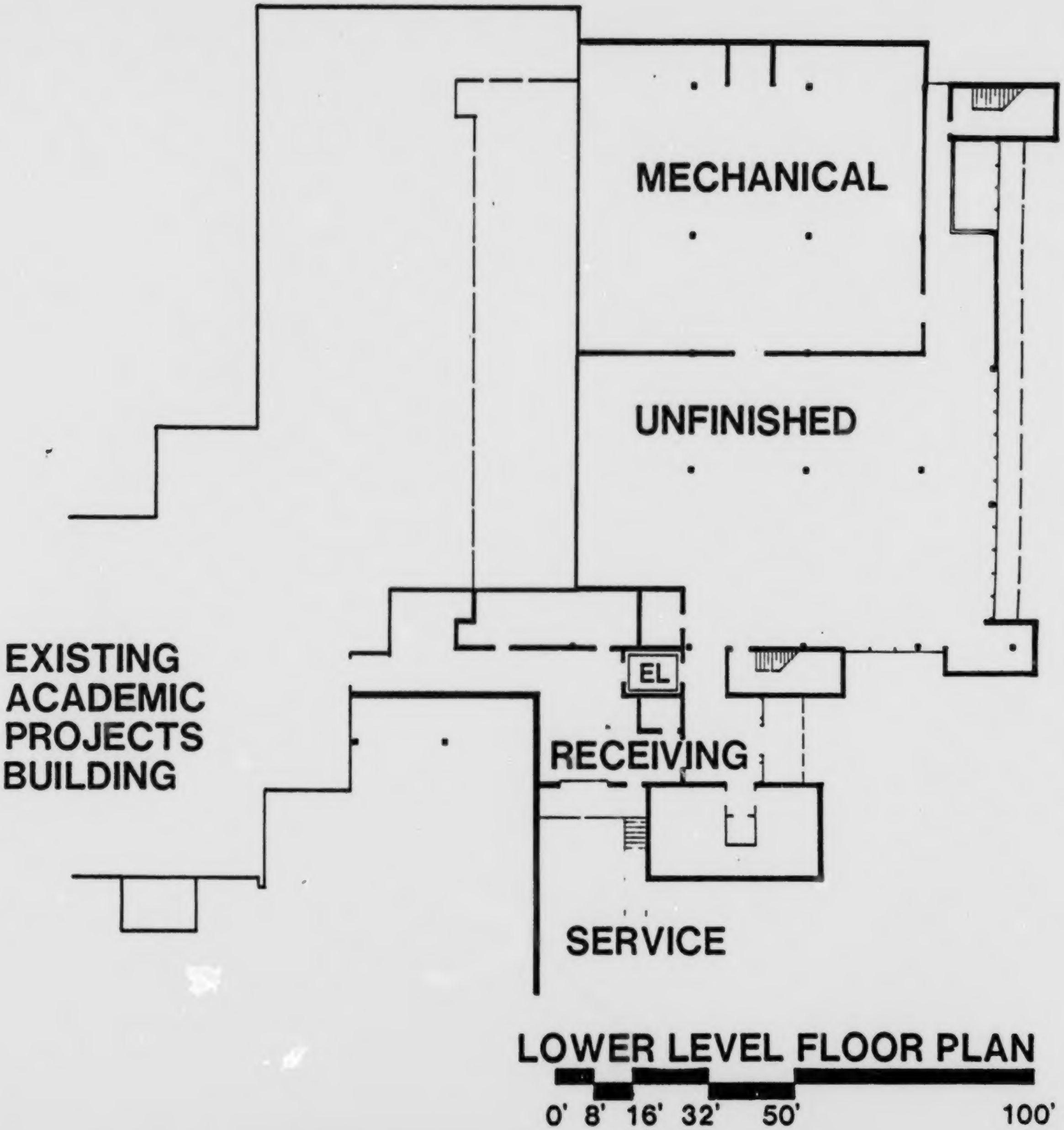
SITE PLAN

197

198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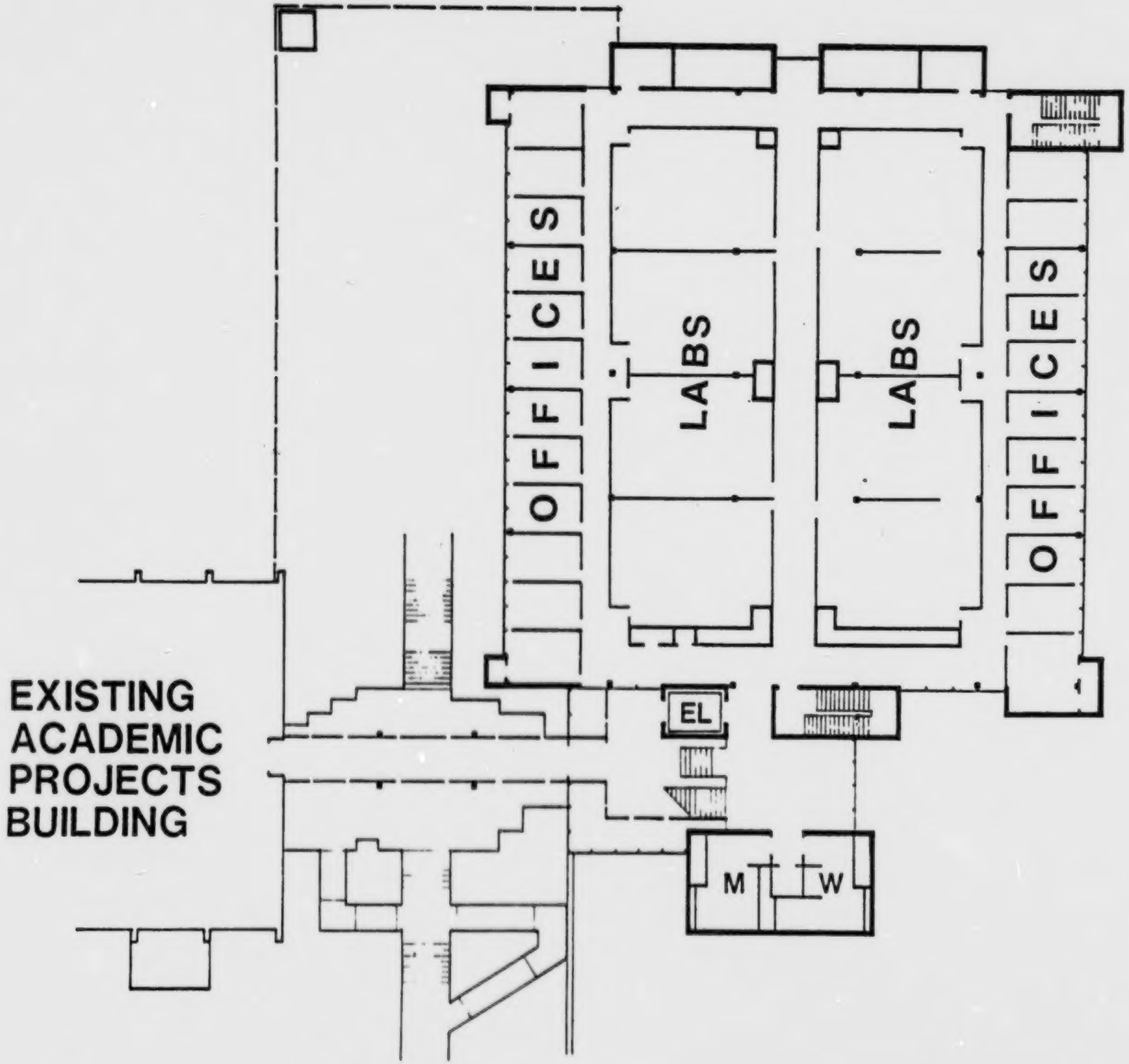
LOWER LEVEL FLOOR PLAN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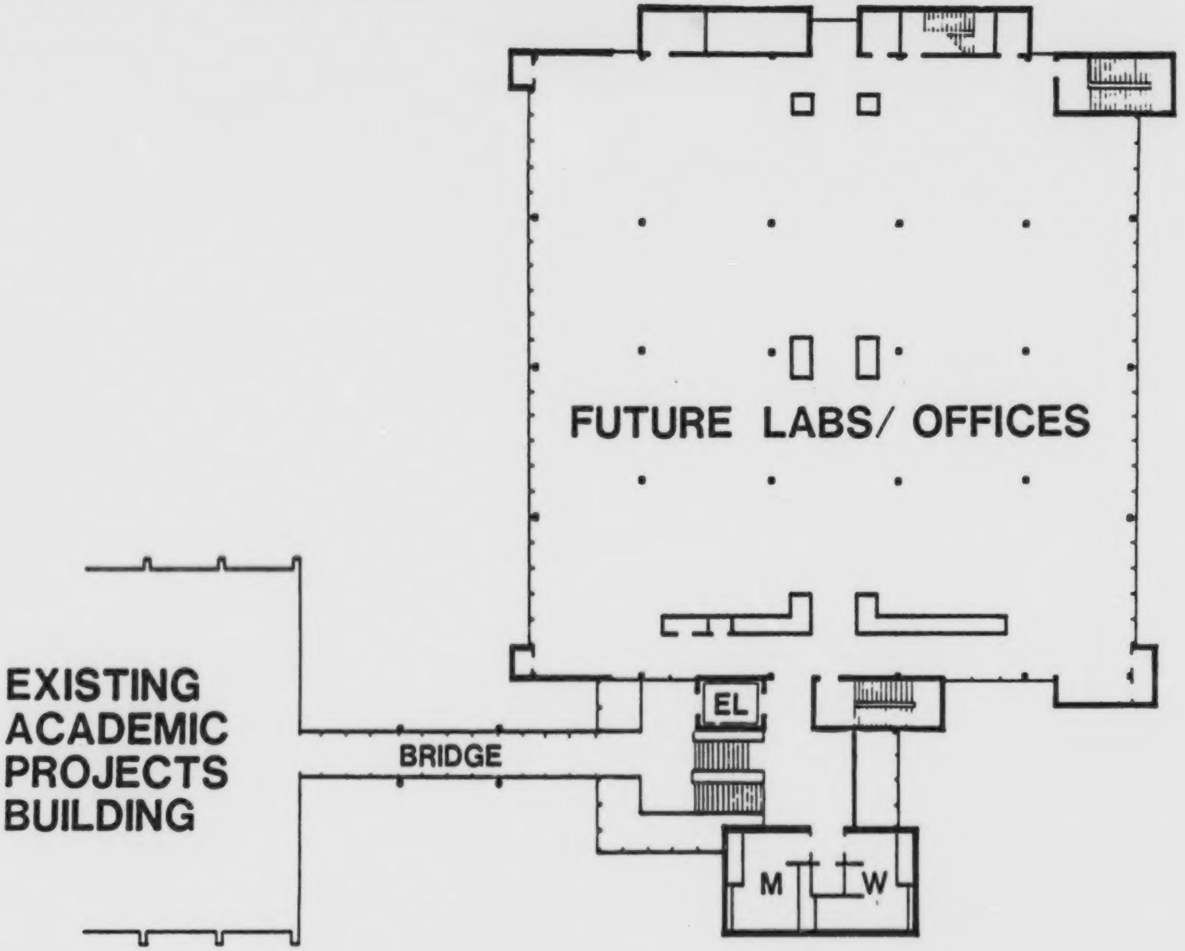
FIRST FLOOR PLAN


FUTURE LABS/ OFFICES
EXISTING ACADEMIC PROJECTS BUILDING
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SECOND FLOOR PLAN

0' 8' 16' 32' 50' 100'

DiDonato

Loew

Reviving a Troubled Construction Project

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I. EARLY RECOGNITION: THE WARNING SIGNS
II. REVIVAL ALTERNATIVES: WHICH WAY?
III. IMPLEMENTING THE REVIVAL PLAN

INTRODUCTION:

Troubled Projects present special problems to the various parties in the construction process. Paramount among them are the issues of how the project will be completed, by whom, at what cost, and within what time frame?

In most cases, communication failures either signal the beginning of a "Troubled Project" or are symptoms of a project already in significant trouble. Once a failure occurs, focus immediately shifts to resolving the problem. The morale of the project participants may be impaired and productivity falls precipitously. Schedules have slipped, trades are being stacked, and sequencing has disintegrated into chaos. Mistakes are being made and shortcuts are being taken to try to get the job back on schedule and the cost more ion line with the budget. If these and other symptoms of a troubled project had been identified earlier, the failure may have been averted.

The first objective of this session is to help the participants in a construction project recognize the symptoms of a troubles project early enough to avoid failures. But, once a failure has occurred, the second objectives is to provide practical insights into how best to get the project back track, and minimize the failures' impact on cost, time and quality.

EARLY RECOGNITION: THE WARNING SIGNS

THE WARNING SIGNS:

The key to preventing a troubled project from occurring is recognition of the early warning signs. What are those signs? Some examples of actual construction projects will highlight the early warning signs.

> Several years ago, a perspective client called and informed me that his $30 million project was about 50% complete, but the general contractor was refusing to proceed any further unless the owner negotiated and settled substantial claims for damages incurred both by his firm and his subcontractors. I interrupted the caller and speculated that he was probably completely disillusioned with his Architect who was administering the project, and that he was shocked and disappointed with the general contractor. I guessed that the value of the claims filed was somewhere between $2 and $3 million over the $15 million worth of work already completed. The caller responded, "You're wrong, the total cost of all claims filed and outstanding is just over $5 million, about one-third of the value of the work completed."
>
> A national hotel chain was constructing a $22 million luxury hotel in a major northeastern city and had signed a Guaranteed Maximum Cost contract with a single local general contractor that called for the completion of the facility within 20 months. When I was contacted, they were in the 30th month of construction, had already approved and paid approximately $1.5 million in Change Orders, and were deeply concerned about the fact that the general contractor had just delivered a claim bound in nine volumes which totaled $9.6 million in value. The Owner had tried to redesign the Hotel from an economy to a luxury facility while construction was underway. The result was an 18-month delay and $3 million in delay damages.

I could give you several other examples, but the story is almost always the same. The real question is, "Why didn't these Owners know that they were headed for disaster? " The answer is that they ignored, or did not recognize, obvious warning signs that could have triggered the early recognition of trouble.

There are five obvious signs which usually serve as a warning that a project is heading for trouble. The five early warning signs are:

- ☐ Delays
- ☐ Change Order Requests and Claims
- ☐ Failed Project Communication
- ☐ Slippage in the Quality of the Work
- ☐ Complaints from Subcontractors and Vendors

Each of these early warning signs deserve a closer look.

PROJECT MOVES INTO DELAYED MODE:

When the progress of the work begins to move into a delayed mode, be alerted that trouble is brewing on your project.

- ○ **Schedule Time Overruns:** The periodic review of the schedule, whether it be a CPM or a simple bar chart is your first sign that delays are occurring.
- ○ **Requests for Time Extensions:** Contractors will begin asking for extensions of time in writing or they will be announcing at job meetings that they are incurring delays and they will provide notification in a more formal manner once they determine the extent of the delays.
- ○ **Work Force Reductions:** During the first two-thirds of the project, the total number of the work force should continue to grow month by month. If that pattern of growth stops or reduces in the number of workmen on site, there are problems which are causing the change in the normal pattern.
- ○ **Disorderly Construction Site:** When I walk onto a site and see disorder in the storage of materials, the maintenance of equipment and tools, and the organization of the work force, I know there is trouble. A sloppy disorganized work site is not only a symptom but also a cause of a troubled project.

CHANGE ORDER REQUESTS & CLAIMS:

All projects have their share of change orders and minor claims over disputes with contractors over interpretations of the contract documents. However, when there is a substantial increase in the submission of change order requests or claims, that is a clear sign of trouble. In addition, a substantial backlog in the number and dollar value of change orders that are in process is not only a symptom of a troubled project but also can contribute to its cause.

- **Change Order Backlog:** The backlog of unapproved change orders will usually be in one of three categories:
    - a. *UNDISPUTED: those which are undisputed, but because of poor administration or lack of funding, have not been approved and issued;*
    - b. *COST DISPUTED: those where the nature of the change is not in dispute, but the value of the cost is in dispute and results in the delay of approval and payment; and,*
    - c. *ELIGIBILITY DISPUTED: where the nature and cause of the work performed is in dispute as to its eligibility under the contract.*

- **Disputed Claims:** Claims for time extensions and delay damages usually involve:
    - a. *ADDED WORK COST: the cost of added work performed because of delays;*
    - b. *ACCELERATION COST: added costs for labor arising from acceleration in order to maintain schedule;*
    - c. *LOST PRODUCTIVITY: the added costs of labor due to productivity losses even when there is no acceleration;*
    - d. *EXTENDED OVERHEAD COST: the added cost to the conduct of the business such as extended home office and field office costs, loss of business, etc.*

PROJECT COMMUNICATIONS:

Failing project communications is a symptom as well as a cause of a troubled project. These failures usually fall into the following categories:

- **Field Communications:** The day-to-day flow of field communications is crucial to the successful conduct of a project. One troubled project site I visited had a row of trailers each about ten feet apart. The first was the construction manager, the second was the project engineer, and the third was the general contractor. Instead of walking to each other's trailers or calling each other on the telephone, each of the three participants mailed each other letters through the U.S. Mail Service.

- **Owner To/From Contractor:** Most of the correspondence on a project between the owner and the contractor is between the owner's representatives on site and the contractor's field superintendent at the field office. When you begin to see an increased flow of correspondence to and from the home office of both the owner and the contractor, trouble is on its way.

- **A-E To/From Contractor:** Crucial to the success of a project is the constant productive communication flow between the contractors and the architect/engineer or construction manager, who is administering the project for the owner. When that flow of communication becomes adversarial and more formal in nature, you can expect trouble.
- **Attorneys & Surety:** When attorneys representing one or more of the parties begin to send letters on behalf of their clients or when letters are addressed or copied to attorneys or bonding companies, once again you can expect trouble.

QUALITY OF WORK:

The continued high quality of work in place is the sign of a healthy project. Therefore:

- **Substitutions:** When a Contractor or his subcontractor begin to submit an abnormal number of requests for material and equipment substitutions, something is wrong.
- **Design Problems:** When the number of RFI's *(Request for Information)* from a contractor or his subcontractors and material/equipment suppliers begins to increase, the contractors are either in trouble or there are major problems with the design documents.
- **Careless Subcontractors:** When the nature of the operations of subcontractors and the quality of their workmanship and materials begins to deteriorate, they have problems under their subcontracts with the prime.
- **Deteriorating Supervision:** When there is a deterioration of quality control and supervision by the prime contractors, or if there is a major change in the attitude of the owner's representatives towards being more strict or less observant, once again, it must be trouble or it will become the cause of trouble.

COMPLAINING SUBS/VENDORS:

If either by reading mail or walking around the site, you begin to notice problems with subcontractors and/or materials and equipment vendors, be aware.

- **Sub/Vendor Stopwork:** If a subcontractor stops work and abandons the site, or if a manufacturer is delaying the shipment of equipment and material, there has to be a problem.
- **Payments and Liens:** When the owner begins to receive liens or notices that liens have been filed against the property or payment demands are made directly to the owner, the prime is usually in the midst of financial problems.

- **Business Failures:** When there are repeated failures of subcontractors of a financial nature, it usually means he is experiencing a cash flow problem. When a subcontractor tells you during a walk around the site that he has not been paid for several months, you have to suspect that he is about ready to leave the site.
- **Supplies and Equipment:** When manufacturers of equipment and material suppliers begin to send their products on a COD basis or if they demand payment before shipment, you can bet they are afraid they will not be paid.

CONCLUSION:

Those of us who have spent most of our careers in construction on-site, develop a distinct talent for reading the condition of a project from what we see and hear as we visit that site for a few hours. Subcontractors, foremen, and even individual workmen are always ready to tell you exactly what they see as a problem on a project site. Most of them will also be just as quick to tell you what a good job it is, if in fact the project is moving along in good fashion.

Managers with experience can maintain a feel for a project by reading key correspondence, the job meeting minutes, reviewing financial documents and by conducting periodic visits to a site. However, those without that kind of experience have to obtain the services of an independent source of information either within their organization or from without.

We are usually asked what appears to be the principle cause of troubled projects based on our experience. Occasionally, there are contractors who either, because of their inexperience or poor financial status, have taken on more responsibility than they can handle. However, we have found that the majority of troubled projects have experienced substantial design changes by the owner during the construction process, or serious design errors or omissions by the Architect/Engineer. There are other causes, of course, but these two happen far more than any of the others. We have also found that on most troubled projects, the participants have lost credibility; the owner no longer knows who to believe or trust, and the contractor may have resorted to overstating his claims in order to get the owner's attention. Finally, the scheduling has usually been in the control of the contractor which has made it more difficult for the Owner to monitor and determine the cause of the delays.

ASSESSING REVIVAL ALTERNATIVES

INTRODUCTION:

Two of the most important issues on any construction project are time and money. These issues become even more important on a project that has experienced a construction failure. Time is important because it means obtaining use and occupancy of the facility. Money is important because a construction failure means that the planned budget may be exceeded or the project participants may be exposed to substantial consequential damages which are not directly related to the failure.

Depending upon the nature of the project, the impact of time and money can vary substantially. Hence, the incentive to invest in a revival plan and the choice of revival alternative will vary depending upon the anticipated loss resulting from the project failure.

- Failure to meet the commercial operation date in a Nuclear Power Plant project resulted in huge losses including:
- Extended overhead costs.
- Increased direct costs from contractors.
- Additional engineering costs.
- Cost of buying power from other sources.
- Substantial costs in the form of Allowance for Funds Used During Construction *(AFUDC)* which continue to accumulate until the plant is operational and can be included in the rate base.
- Additional delays due to regulatory requirements.

The costs for delays to Nuclear Plants, where the utility has been shown to be imprudent, have been excluded from the rate base in the present regulatory climate. On one plant, the disallowance by the Public Utility Commission has exceeded one billion dollars.

- Failure to complete a Casino Hotel on time resulted in substantial losses including:
    1) *Loss of seasonal and competitive advantage.*
    2) *Loss of gaming revenues.*
    3) *Loss of revenues from hotel, restaurants and shops.*

    4) *Payroll costs for the operational personnel who must be licensed, trained and on board well in advance of the opening date.*
    5) *Potential loss of license to operate.*

- Failure to timely complete a public works project such as a Sewage Treatment Plant did not result in substantial loss since:
    1) *Costs of operating* (power, chemicals, etc.) *the old facility was cheaper.*
    2) *Saving were realized from delaying the hiring of additional operating personnel.*

However, in some instances the delay in completing a Sewage Treatment Plant could result in substantial fines for non-compliance with EPA regulations. Also, there may be political ramifications such as moratoriums on the issuance of residential and commercial building permits and restrictions on water usage.

The point of these examples is that time and money considerations dictate the selection of the program to revive a failed project.

There are three major courses of action to reviving a troubled project. The first alternative is to terminate the contractor*(s)* whose acts or omissions represent or are responsible for the project's failure. After termination the project is completed by a replacement contractor hired by the owner or surety.

A second alternative is to terminate the contractor and manage the completion of the work with the existing subcontractors and/or selected replacement subcontractors.

The third alternative is to negotiate with the contractor responsible for the failure and attempt to manage the completion of the project in the most timely and cost effective manner possible.

Obviously the most drastic and risky course of action is the decision to terminate the contractor. A decision to terminate must first be based upon the examination of several legal issues which are beyond the scope of this presentation. However, even if a legally defensible termination for default can be proven there are several practical effects which must be considered.

Since the primary thrust of our presentation is discussing the options for getting the project back on track, we would like to focus on the options for revival through the eyes of the owner, generally the one having the greatest stake in a troubled project. Obviously the construction manager, general contractor, subcontractors or other project participants may have the same incentive to revive the project. However, their primary motivation may be to settle their claims as a precondition to participating in the revival program.

THE NATURE OF THE CONTRACT(S):

The construction contract*(s)* may take many forms. The nature of those contracts should be taken into consideration when assessing the various alternatives for reviving a troubled or failed project. The contracts might be:

- ☐ public or private
- ☐ single or multiprime
- ☐ lump sum or unit cost

Public or Private

On a public project the decision to terminate a contractor may have far reaching consequences. First, because of the public bidding laws a public body or agency is generally precluded from entering a contract with a successor contractor without advertising for bids. Hence, unless the surety is willing to contract directly with the successor contractor *(which they are often unwilling to do)* a long delay could result in obtaining a successor contractor. This not only results in delays in completion of the project but also, on a multiprime project, claims from other contractors unrelated to the default. Second, if the public body is forced to advertise for bids a new set of plans and specifications will be required to define the scope of the completion contract. This only adds to the delay in getting the project back on track and results in additional fees and expenses from the A/E.

Finally, if the public project is funded by a Federal agency such as the EPA the funding could be in jeopardy. If there is a dispute concerning the basis for the termination and the contractor has claims against the owner the funding agency may conclude that there has been grantee mismanagement and limit the funding available for the completion contract.

With a private contract the owner does not have any legal restrictions on his ability to hire a replacement contractor. However, a private owner may have more economic constraints since a termination may entail completion costs which are two to three times the remaining contract balance. In addition, the delays in replacing a terminated contractor and resulting loss of use of the facility typically have a much greater economic impact on the private owner.

Single or Multiprime Contracts

With a single prime contract where the majority of the work has been subcontracted, it may be difficult to maintain the same subcontractors on the project. If the Prime has mismanaged the project and not paid the subs there may be substantial claims filed and liens placed on the project by the subcontractors.

With a multiprime project it is generally easier to terminate one of the primes without having a major impact on the entire project if the work is re-let in a timely manner.

Lump Sum or Unit Cost

With a lump sum contract a default termination will result in inadequate funds to complete. Contract balances and retainage are likely to be substantially less than the cost to finish the project due to: a) front-end loading by the contractor, b) payments for material and equipment which may not be recoverable, and c) the contingency typically required by the replacement contractor.

With a unit cost contract, such as a pipe line project, it is much easier to establish the physical status of completion. It is less likely that the contractor has been overpaid for the work in place.

Attitude of Major Subcontractors

The attitude of the major subcontractors *(mechanical, electrical)* has a substantial impact on the ability to complete the project. If the subs are aligned with the defaulted prime they may refuse to perform or be unwilling to release major pieces of equipment *(switchgear, chillers)*. Conversely, if the subs have not been paid or have been otherwise damaged by the Prime they may be cooperative with the owner. Typically, such cooperation has a price.

STATUS OF THE PROJECT:

After a troubled project is recognized, the most important task is to determine the completion status of the project. Determining the status is important not only as to whether to default the contractor or negotiate but also dictates the various actions that might be taken to get the project back on track *(i.e., acceleration, resequencing of activities, etc.)*.

Percent Complete

The primary indication of the status of a project is the percent complete as reflected in the payment applications approved by the A/E or CM. When there has been a performance failure in the early stages of a project *(less than 25%)* it is typically less disruptive to terminate and replace the contractor. Furthermore, if the contractor exhibits the financial or technical inability to perform at an early stage it may be indicative of greater problems if the contractor is allowed to continue. Conversely, in the later stages of a project *(over 50%)* the impact of replacing a contractor is much greater due to the stage of construction and his familiarity with the project. In addition, it is much more difficult and costly to find a suitable replacement contractor because of uncertainties regarding the adequacy of the installed work and the scope of the remaining work.

Location of Materials and Equipment

Access to key pieces of equipment and material is an important factor to be considered if termination is one of the options for revival. If the equipment or material is stored on site it is a simple matter to take possession. Obtaining possession may be more difficult if the equipment is stored off site or at the manufacturer's facility. Securing equipment such as switchgear, chillers etc. is extremely important because of the long lead time required to obtain the equipment.

Owner's Occupancy Requirements

One of the most important considerations in deciding upon a course of action for reviving a project is the owner's occupancy requirements. A good illustration of the importance of obtaining occupancy in a timely fashion is the Casino/Hotel project mentioned earlier. In this case the casino operator was faced with the loss of its temporary license to operate if not opened by the end of the year and would have been required to go through the entire licensing process a second time. This could have meant a delay of up to one year before they could be relicensed and operating. Because of a variety of project delays the casino had missed the summer season in Atlantic City. In addition, the Casino was in danger of losing the substantial gaming revenues which peak between Thanksgiving weekend and New Years. After significant acceleration efforts of key trades the certificate of occupancy was obtained and the casino opened the weekend before Thanksgiving. The gross revenues for gaming between Thanksgiving and the end of the year totaled millions of dollars.

Another case was a corporate headquarters building in Connecticut which was to house thousands of employees in fifteen *(15)* different locations in Manhattan. In both these cases termination was not a viable alternative because of the consequences of delaying occupancy resulting from bringing in a replacement contractor.

Financing Arrangements

Another important consideration to termination is whether the owner has sufficient financing if the surety refuses to perform. On public projects funded by EPA grants this becomes a particularly difficult problem. Long delays can be associated with obtaining additional grant funding to complete a project.

Similarly on a recent Airport project the construction of the facility was financed by revenue bonds. Because of an inadequate original estimate and costs expended to remedy defective work the owner was required to issue additional revenue bonds at a substantially higher interest rate and also absorbed the underwriting fee for the bond.

Position of Surety

Once a termination for default is issued the surety investigates the project to determine whether it is obligated to perform under the performance bond. If the surety determines that it does not have any defenses to the termination it will chose one of the following options:

1) Complete the project with its principal.
2) Tender a new contractor to complete the work under a contract between the owner and the new contractor.
3) Tender a new contractor to complete the work under a contract between the surety and the new contractor.
4) Allow the owner to directly obtain a new contractor to complete the work. The surety would then be responsible for paying the cost of completion in excess of the contract balance at the time of the default up to the penal sum of the bond.

If the surety determines that its principal has been wrongfully terminated or that there are other defenses *(overpayment, etc.)* the owner may be left to its own resources to complete the project and proceed to recover the damages through litigation with the surety. This risk must be factored into the evaluation of whether to terminate. If there is a chance that the surety will not come in on the bond the owner must have the financial resources to complete the project on its own and also be prepared to litigate with the surety and the terminated contractor to recover its losses.

NATURE OF THE PROJECT FAILURE:

The first issue to be examined when assessing the revival alternatives is the nature of the disputes on the project. Typically on a troubled project the non-performance of a contractor is not the only issue that must be dealt with in implementing the revival program. For this reason it is often difficult to determine from a factual standpoint whether the contractor may have legitimate defenses to a default termination. Consequently the decision to terminate is risky. It has been our experience that only where the contractor has exhibited either the technical or financial inability to perform on has wrongfully abandoned the project does the termination option become the clear choice. But even in these circumstances there are exceptions to the rule.

Contractor Failures

The nature of the contractor's failure to perform can run the gamut from failure to submit shop drawings on time to failure to meet the project completion date. However, only certain acts as defined in the termination provision of the contract or a material breach of the contract are sufficient to justify a termination.

Owner Interference

Often the troubled project is plagued by acts or omissions by the owner which may have precipitated or aggravated the performance failure of the contractor. A prime example of this type of interference are changes issued by an owner right up to the completion date of the project.

Other examples of interferences by the owner or its agents would include:

- ☐ defects in the plans and specifications
- ☐ changes in the method or manner of performance
- ☐ failure to coordinate the work
- ☐ improper inspection or rejection
- ☐ owner non-disclosure of material information

Changed Conditions

A changed condition, such as a differing site condition, may be the cause for the performance failure rather than the mismanagement or incompetence of the contractor. In such cases the primary focus of the revival should be; a) the determination of whether in fact a changed condition existed b) a determination of the costs and time impact of the changed condition and c) a determination regarding the remedial measures to be implemented.

Acts of God

Sometimes the construction failure may not be the fault of any of the parties and can be considered an Act of God.

We were recently involved in an Airport project where the paving contractor had been terminated for deficiencies in the embankment for the main runway. After remedial work was completed by a replacement contractor a sink hole developed in the main runway which further delayed the project. After a thorough investigation it was determined the the sink hole was not the result of a design defect or deficient construction practices and was considered an Act of God.

PROS AND CONS OF REVIVAL ALTERNATIVES:

The advantages and disadvantages of each of the revival alternatives are summarized.

1) Terminate and Rebid *(Owner and Surety)*

Advantages:

1) Obtain contractor with financial/technical ability to perform.
2) Minimize loss (early stage).

Disadvantages:

1) Increased costs
2) Delay in completion.
3) Risk of surety refusing to honor bond.
4) Difficulty in obtaining equipment and material.
5) Cost of litigation.

2) Terminate and Manage *(Owner or Surety)*

Advantages:

1) Avoids delay in replacing contractor.
2) Minimizes loss.

Disadvantages:

1) Increased costs
2) Requires expertise.
3) Subcontractors may not cooperate.
4) Surety may refuse to honor bond.

3) Negotiate with Present Contractors

Advantages:

1) Cost effective.
2) Expeditious.
3) Performance can be dictated as requirement for settlement.
4) Limitation on future claims exposure.

Disadvantages:

1) Requires expertise
2) Potential for overpayment on claims and changes.

The point to be made is that even when there has been a performance failure by the contractor it is important to analyze the project to identify other circumstances which may have precipitated the failure. Any plan for revival must include not only the specific performance failure but also the other conditions which may be less visible but just as important to successful completion of the project.

IMPLEMENTING THE REVIVAL PLAN

INTRODUCTION

Once one has recognized the early warning signs of a troubled project and has assessed the revival alternatives the next step is to implement the revival plan. Hill International has been successful in a number of construction failures and has developed a proven formula for turning around a troubled project.

Implementation Plan

The Selection and Organization of the Revival Team — The most important step in turning around a failed construction project is the organization of the core revival team. In selecting a team is is vital to choose a project leader who is a strong, competent manager, and a person who truly understands the construction industry. To turn around a troubled project, the project leader must possess both qualities. It should also be recognized that there can only be one leader and his or her authority and responsibilities must be established very quickly. The project leader selected must also have a personality, which allows him to be rational and reasonable during the heat of the crisis caused by a failed construction project. Throughout the extremely stressful turn-around process, all the parties to the project must have the confidence that rational, but prompt, decisions will be made on a consistent basis. The importance of prompt decisions in the revival process cannot be overlooked or underestimated. The person filling the leader's role must be equipped to handle all issues in a calm and decisive manner.

The selection of the members of the "Revival Task Force" is second only to the selection of a project leader. It is important to select the best people available. The team must include every major discipline of construction. The project revival team needs to give their undivided attention to the turn around of the project. Therefore, they must be free of all other assignments until the revival is complete.

Identification and Understanding of the Problems — The first item on the team's agenda is to identify the project problems. Many of the problems will have already been identified during the problem identification phase discussed earlier. Despite the preliminary identification of problems, additional problems will surface upon in-depth analysis. It is important for the team to understand fully each of the problems, identified through their interviews and walk-throughs. It is imperative that each identified problem be clearly defined by the team. The common wisdom of "You can't solve a problem until you understand what the problem is and why it is there" has never been truer than during a troubled project. The problems which may be uncovered include: site/water/rock conditions, delayed materials and equipment, shortages of tools and equipment, etc. There may also be problems involving the architect and engineer, including errors and omissions, timely approval of drawings and inept and/or slow decision making.

These issues are often very sensitive. They must be addressed and resolved as soon as possible.

The problems uncovered go beyond site conditions, materials or drawings. For a failed construction project there can be significant problems in the area of overall management of the project including the supervision. Often problems occur when supervisory levels are stronger than management. Problems exist with labor. Often labor is given the blame for a failure. In many of our experiences, it was the owner himself who posed the greatest threat to the project.

Defining and Managing the Objectives — For the revival to be successful, it has to be managed by clear, concise and realistic objectives. Having clearly identified the problems, the team must recognize, even with all the chaos around them, that they must take the planning time required to set the objectives. The need for adequate planning time cannot be overstated. The project team must be available to work long hours in order to find timely solutions to the problems. While planning, they must also strategize the methods, procedures, and personnel resources required to reach the objectives. The objectives should include:

- The determination of the earliest, realistic completion date
- Providing the owner with the best possible estimate of the final completion cost
- Identification of the resources, including people, money, and control procedures needed to accomplish the objectives
- The overall team, including the owner, management, supervision, and labor must be unified at the earliest possible time. This may require the replacement of some or all of the top members of the team. It can be done, though difficult, with everyone staying in place if the leader is strong enough and the purpose and benefits to reviving the project are clearly defined and set.
- There absolutely must be constant and consistent coordination and communications with all of the parties to the construction project. This communication is needed from the Top Management of the company or agency building the project to the laborers who will be removing the last load of trash from the site. It is extremely important to keep all of the regulatory and licensing officials informed as well. The best scheduling plans can be destroyed if one does not have the cooperation of the people who must provide the ability to use the project.

- In order to know exactly where the project stands and which remains to be done, it is absolutely necessary that the work remaining within each contract discipline be estimated by units of work left to complete. This will permit the determination of **what has to be done on a daily - weekly - monthly** and overall basis in order to reach realistic time and cost objectives .

- Geographical work plans have to be created so that the resources which have been designated are utilized both effectively and efficiently.

- Morale must be kept upbeat. One effective way to accomplish this is to make every conceivable party to the project a part of a task force that is responsible for a major element of the Revival Plan. Also, there has to be some reward in it for everyone which goes beyond just the pride of having been a part of completing the project.

Once the objectives have been identified, it is necessary to manage those objectives for turning around the failed project. The revival team must review their adherence to the objectives on a daily, weekly, and monthly basis. Before closing shop each night, the daily objectives for the next day must be set. In addition, there should be goal setting for every member of the task force as well as each member of the team including the architect/engineer, the contractors, the vendors, labor and, most importantly, the owner.

Key Meetings — One cannot overstate the importance of key meetings to review and monitor all the objectives. These meetings, of necessity, **must be formal, regularly scheduled, completely organized,** and **start and finish on time.** In a Troubled Project, one often finds that key review and coordination meetings are disorganized, are not held on a regular basis, and do not have established starting times, agendas, or finishing times. The result is either people do not come to the meetings or they send people to the meetings who cannot make the decisions required. Our experience with troubled projects indicates that it is beneficial to schedule certain people at specific intervals in order that we do not waste valuable time of many people listening to reports or objectives that *(although meaningful to them)* they cannot effect.

Scheduling and Cost Adherence — It should be recognized by all involved in the revival of a failed project, that there must be a schedule that is realistic, and understandable by all the parties. It should identify each important milestone, and be consistently updated so that task force members know exactly where they are at all times. There must be plans for workarounds of any potential deviations and it is absolutely necessary to eliminate all or most of the obstacles to achieving time and cost objectives. With the proper planning, proper resources, and the cooperation of all the parties, it is a rare obstacle that cannot be eliminated.

Perhaps most important, is that **ALL CHANGES MUST STOP**. There can be little deviations from that procedure. If changes must be made, let them be made after the project is on line, even if it costs a few more dollars. In a troubled situation, changes may provide the contractors with an excuse as to why it will cost more or take more time. In theory, the contractor may allege that it was the change, not his performance which was responsible for exacerbating an already bad situation. The team should constantly be striving to accelerate the critical path activities because, as we all know, obstacles will show up that require prompt attention. In other rare cases, there will be some obstacles which cannot be so easily overcome. Therefore, the importance of trying to compress critical path activities wherever possible is clear.

Changes and Claims — In most Troubled or Failed Projects, the one thing that is sure to emerge is disagreement on change orders and claims. Therefore, these issues have to be addressed in a very rapid and aggressive manner and decisions reached that **allow the contractors to build the project and not build claims**. Most important of all the elements of getting this area of the project cleaned up is that **the Revival Team must obtain the trust of all parties**. They must be credible, objective, and immediately address this very dangerous area. They should make a complete list of all outstanding and potential change orders and claims, set priorities based on what needs to be done on the project and then begin to immediately:

- Assess the individual damages both hard and soft cost, and determine in an objective manner what is equitable for the parties
- Overcome "pride and suffering" damages. Very often, the crux of the inability to settle some of these issues is based more on personality and emotion than on fact. The team leader must find a way to zero in on the factual circumstances and steer away from emotionalism. Once having reviewed the situations and made equitable determinations, the owner's team must react with prompt decisions - one cannot afford the luxury of procrastination in this highly volatile area. As stated before, one must get the entire team back to building the project and not counter productive claims.

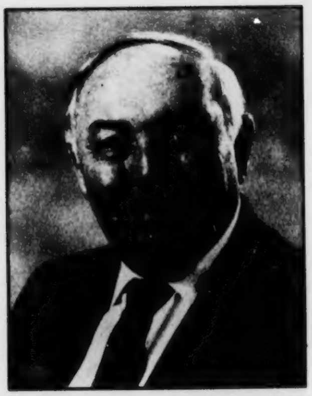
There are three constant objectives that must be always be kept in the forefront of the minds of all the members of the revival task force. They are:

☐ TIME - Importance of the Schedule
☐ COST - It ain't the Money - It's the Money
☐ PRIDE - Getting everyone involved in the project and proud of what is happening will bring about the desired results

PLEASE RECOGNIZE THAT IF ALL THE ABOVE HAD BEEN DONE FROM THE START OF THE PROJECT, THERE WOULD NOT HAVE BEEN A "PROJECT FAILURE IN THE FIRST PLACE"

77th Annual Meeting
Ottawa, Canada

Physical Plant Operations and Maintenance



A Project Management Approach to Managing Work Control

Roy C. Allen
Director, Facilities Resources
U.T.M.D. Anderson Cancer Center

Introduction

Plant management has historically relied upon custom tailored maintenance management programs to manage maintenance planning, execution and tracking. Many of these systems are directed at accomplishing projects in a timely and efficient manner, using project management techniques applied to plant maintenance management as well as construction/renovation projects.

Project management software available for use on today's powerful personal computers opens a new world for Physical Plant managers. Creative use of these systems allows for a much improved maintenance management function, particularly when planning manpower loading and capturing costs. Through the new inter-connectivity of computer hardware and software, existing systems dwelling on mainframe and mini computers, can be tied together to yield much more effective project planning and management.

It is the purpose of this presentation to discuss the University of Texas M.D. Anderson Cancer Center's application of this technology to its work planning and control systems.

Why Project Management?

In today's world the facilities management function consists of projects which are many and varied in scope. In addition to on-going preventive maintenance, response calls and repair projects, facility managers deal with minor construction, renovation and coordination of major construction projects. All of these functions carry a common thread; they require the use of planning, scheduling, and control techniques to bring the projects in on-time, on budget.

The work control function is usually assigned responsibility for overall project accomplishment. The project management techniques that are used in work control include planning, scheduling, and control techniques, adjusting for change (reality), rescheduling and performance measurement. Before launching into a discussion of our activities at M.D. Anderson, let's review some details that are key to the project management function:

Planning

Planning is the key to the success of plant and project management. Planning efforts require well defined project objectives, the ability to break the work down into identifiable work packages, a clear understanding of the resources required and agreed upon time deadlines. In Physical Plant planning the project may range from those relatively minor in scope to those as involved as a major renovation of a building while the building is still occupied. It could even involve major construction projects which will require extensive planning and coordination with outside agencies. Regardless of the scope, the quality of the final product is directly proportional to the investment made in the planning phases.

Scheduling

Scheduling is the logical extension of the completed plan. When scheduling physical plant work projects, minor construction or major design and construction projects, money, manpower, and materials must all be brought into play at exactly the right time and the right place in order to ensure the most efficient utilization of all.

Resource Allocation

Resource allocation, the balancing of scarce resources and coordination with the schedule, is extremely critical. From initial project inception through to completion, the project manager continually shuffles the available resources to meet schedule demands.

Cost Information

Obviously costs are a major concern for all projects. Funding and budgetary constraints require the project manager to know at all times the status of his costs from the planning through to the end of the project.

Adjusting for Change/Rescheduling

Key to the success of any project is the flexibility to adjust for change. No project proceeds exactly as scheduled and no project stays on budget as forecasted. The project manager must therefore be very flexible in his approach to management. He must be constantly aware of the status of the project and when necessary needs to adjust the project by rescheduling resources as necessary. The criteria listed above are generally the elements of the management of any project. They are universal.

Using Project Management Software to Manage the Plant Workload

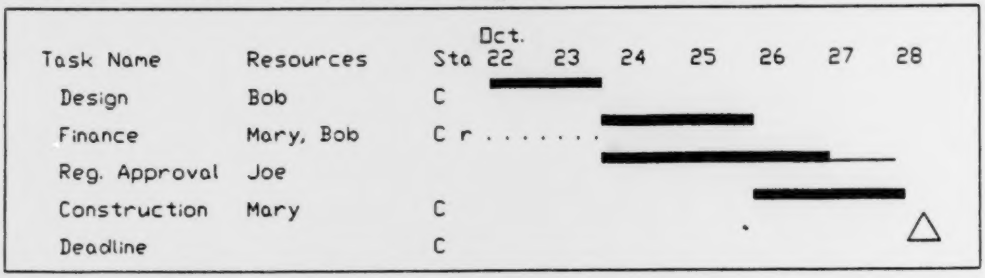
In the last six years a number of micro-computer based software packages for project management have become available. These can greatly aid the work management and control functions in Physical Plant. In general these packages are relatively inexpensive, easy to learn, and can be implemented relatively quickly. The designers of these packages have created powerful systems that only a few years ago would have required a vast commitment of mainframe computer resources. They bring with them such planning and scheduling tools as Gantt charts, resource histograms, multiple project tracking, critical path capabilities, resource allocation tools and the ability to generate a wide variety of custom tailored reports. These packages allow management to look at various "what if" scenarios when managing multiple projects and enable consideration of economic and resource trade offs.

As in the case with any "packaged" software no project management package is perfect. All packages must be modified in some ways to meet the needs of individual users.

The following are examples of the tools available:

Gantt Charts

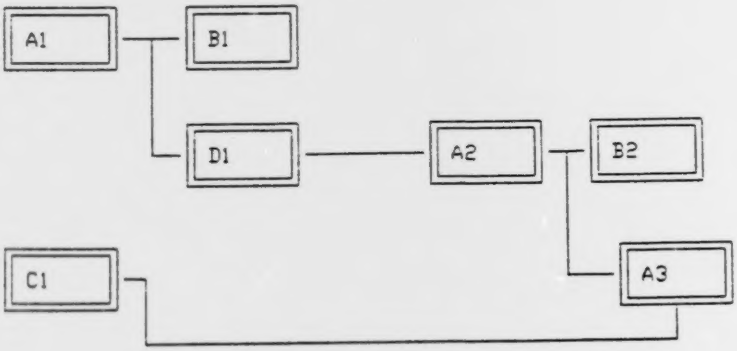
On-screen Gantt charts show a date line along the top of the scale with a bar graph below which shows the timing of various tasks along with resources committed and any slack time that exists before a task can begin.



If the planner wishes to change assumptions the software allows for instant recomputation of the entire schedule taking into account available resources and time constraints.

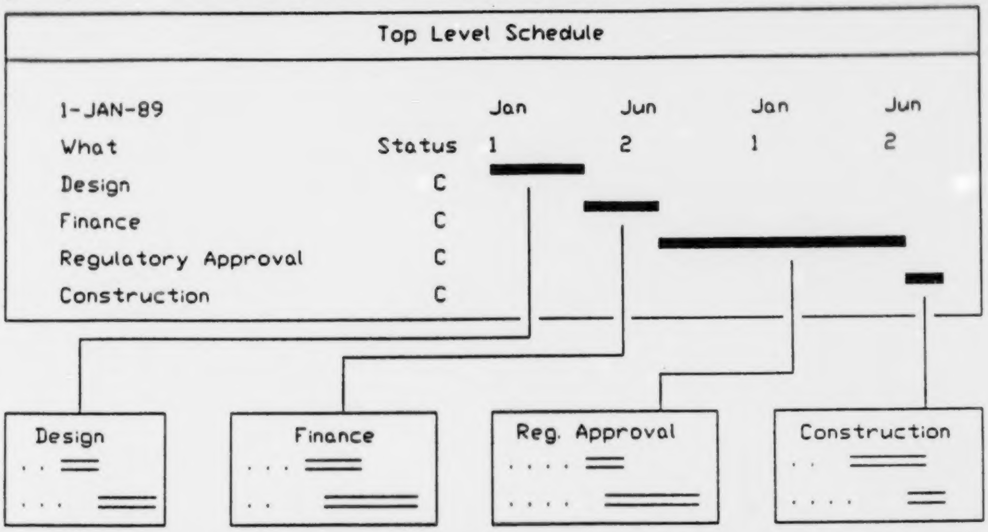
Network Diagrams

"PERT" Program Evaluation and Review Technique diagrams allow the planner to view the project as a network of interrelated tasks which function together. These network diagrams can be very powerful because they allow the planners to see the inter-relationships and dependencies between the various elements of the project.

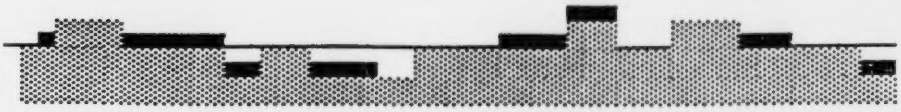


In the example above, the on-screen display indicates that all of the tasks associated with task "A," could not be accomplished until certain other tasks associated with other elements of the project were completed.

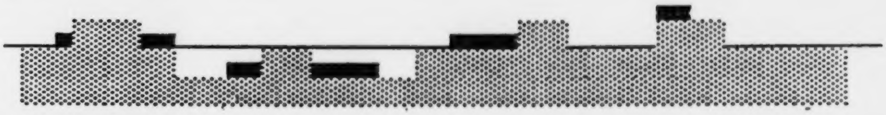
Project Management packages have features that allow top level scheduling. Detailed schedules can be rolled up into executive level information. Several schedules can be merged together or subschedules can be rolled into a master schedule.


Top Level Schedule
1-JAN-89
Jan
Jun
Jan
Jun
What
Status
1
2
1
2
Design
C
Finance
C
Regulatory Approval
C
Construction
C
Design
Finance
Reg. Approval
Construction

Resource allocation features on the scheduling packages allow the planner and project manager to adjust schedule deadlines or apply more resources to areas where overcommitment exists. The Histogram is a useful tool for making these decisions.



Resource A @ 100% 1.0



Resource B @ 100% 1.0

Displayed across the "Y" axis is the timeline. The "X" axis displays the percentage of commitment of the resources being analyzed. The horizontal line on the scale represents 100% commitment of any resource. Projections above the line indicate overcommitment of resources while projections below the line indicate additional resource availability.

Project Tracking reports are invaluable aids to the project manager both in the planning and progress reporting phases. All project management software packages provide for numerous custom tailored reports. All are designed to provide the project manager with real time information to manage the project.

TYPICAL PROJECT REPORT EXAMPLES

Report Type	Information Available	Available
Status Reports	Identifies tasks currently underway, just completed or about to begin.	On line, on request.
Cost Reports	Identifies planned costs vs. actuals, underruns, overruns.	On line, on request.
Resource Reports	Measures available resources against time and other parameters.	On line, on request.

Adjusting for Change/Rescheduling

All of these features add up to the most important factor for the project manager, which is the ability to know where he is at all times. With the proper information fed into the computer the project manager can use the computer to assist in managing to successful completion.

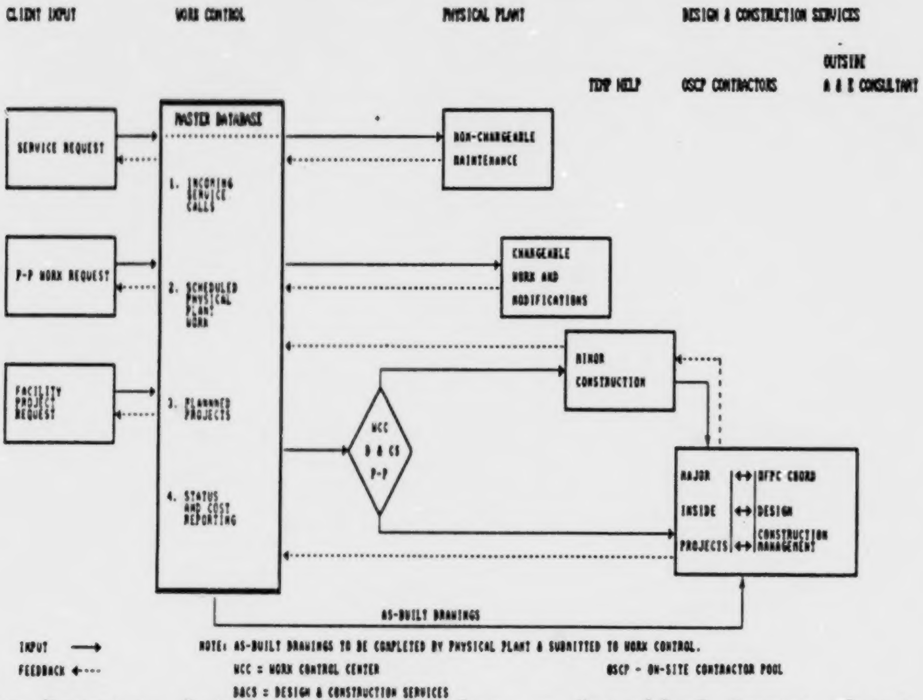
Now let me describe the way that these tools have been used in developing our work control systems at the University of Texas M.D. Anderson Cancer Center.

Institutional Description:

M.D. Anderson Cancer Center was founded in 1941 by the Texas State Legislature. Over the years the complex has grown to include over 3 million square feet of floor space in 76 buildings dedicated to patient care, academics, research, and administrative support functions. Adding to the administrative challenges are the maintenance of a research farm and a research park each located approximately 180 miles from the main campus. Due to the "high tech" nature of the programs, facilities are constantly undergoing modifications.

Modifications may range from projects supported with Physical Plant personnel ranging upward to $100,000-$150,000 managed by the Physical Plant, to locally managed minor construction projects in the $100,000-$300,000 range managed by the Design and Construction Services group. Major projects over $300,000 in which the Cancer Center is involved require detailed coordination with the University of Texas System Office of Facilities Planning and Construction (OFPC). Coordination with numerous information sources is necessary to keep the information properly updated as is demonstrated by the following diagram:

FACILITIES MAINTENANCE & MODIFICATION PROCESS


CLIENT INPUT
WORK CONTROL
PHYSICAL PLANT
DESIGN & CONSTRUCTION SERVICES
TEMP HELP
OSCP CONTRACTORS
OUTSIDE
A & E CONSULTANT
SERVICE REQUEST
P-P WORK REQUEST
FACILITY PROJECT REQUEST
MASTER DATABASE
1. INCOMING SERVICE CALLS
2. SCHEDULED PHYSICAL PLANT WORK
3. PLANNED PROJECTS
4. STATUS AND COST REPORTING
NON-CHARGEABLE MAINTENANCE
CHARGEABLE WORK AND MODIFICATIONS
MINOR CONSTRUCTION
WCC
D & CS
P-P
MAJOR
INSIDE
PROJECTS
OFPC COORD
DESIGN
CONSTRUCTION MANAGEMENT
AS-BUILT DRAWINGS
INPUT
FEEDBACK
NOTE: AS-BUILT DRAWINGS TO BE COMPLETED BY PHYSICAL PLANT & SUBMITTED TO WORK CONTROL.
WCC = WORK CONTROL CENTER
OSCP - ON-SITE CONTRACTOR POOL
D&CS = DESIGN & CONSTRUCTION SERVICES

The "master database" is in fact a detailed Gantt chart containing over six hundred (600) projects of varying size and scope.

Using this project management software all institutional projects are periodically updated in the master database. Individual user departments maintain their own databases. The files on Physical Plant work orders and minor construction projects are maintained by Work Control. The Design and Construction Services department maintains their own schedules as well as those being coordinated with OFPC. Via networked PCs these schedules are merged periodically into the master database to produce an overall view of the work to be done.

Work Control maintains the master database. By far the largest number of items entered into this database consists of Physical Plant work requests (approximately 300 per month). Work Control coordinators and job schedulers evaluate the work requested and, working with the Physical Plant managers, establish a plan to accomplish the work. For minor projects the individual work request is entered into the Gantt chart as a single line item (task). For more complicated projects, individual schedules are developed.

At weekly supervisor meetings these Gantt charts are reviewed with appropriate management personnel and the schedules are adjusted to take into account changes in priorities, resources, etc. After the system is updated, reports are then filed on project status using the reporting features of the project management software.

As part of the system, periodic reviews are held with Design and Construction personnel in the same manner as with Physical Plant. Once agreement has been reached, the schedules are finalized and "rolled up" into the final master database. From this database the master Gantt chart is constructed and custom reports are generated according to the needs of the individual client departments.

The data input process to capture the information necessary for this process is highly labor intensive. To ease this burden and to give the client a better input to the process, a project has just been completed to place work requests "on line" with clients at over 1700 existing mainframe terminals. With this system the client can request a project on the IBM 3090 mainframe computers. The requests are downloaded daily into the project management software.

Every day all client requests are loaded into a queue. That queue then is worked by a work coordinator or job planner, the jobs are reviewed, prioritized and scheduled. They are then "uploaded" into the IBM 3090 system so that the client can have immediate feedback on scheduling information and projected cost. Included in the job coordinator's evaluation is his estimation of the materials needed on the job, the time required, and the available resources.

Summary

Facilities management can be enhanced with the application of commercially available project management software. These software packages can be obtained relatively cheaply and are easy to learn, thereby reducing training and implementation costs. Like all "canned" software they must be modified to meet individual needs. At M.D. Anderson Cancer Center these techniques have been used for the past four years with increasing success.

All Physical Plant work requests have been loaded into project management software and scheduled utilizing the computer's ability to handle massive amounts of data. This capability has recently been expanded to include design and construction and long-range planning projects as well. This capability has been further expanded to allow interface with the institutional mainframe computers such that authorized personnel on any of 1700 terminals can enter a request for work. The request is then downloaded to the project management software, scheduled and then the information is loaded back onto the mainframe so that the client can be informed of the scheduled start dates.

As a result of these innovations, work control personnel are now able to monitor and schedule all planned work in the institution. The clients are kept apprised of the work being accomplished by a convenient, readily available information source and Physical Plant, Design and Construction Services and others are able to benefit from a central source of data on all work in the institution.

New Maintenance Practices and Technology

Adley Abdel Fattah
Assistant First Deputy
Arab Maritime Transport Academy

Abstract

The key to efficient management and maintenance either preventive or corrective is twofold: sound planning and a wealth of functional database.

Quoting the syllogism of good managment " In order to manage, you must control. In order to control, you must measure, therefore, in order to manage you must measure ", measurement summerizes the basic philosophy behind a management approach to maintenance. In the following, the Arab Maritime Transport Academy (AMTA) new - built campus presents a case which bears evidence to that.

Background

The Arab Maritime Transport Academy (AMTA) is a specialized educational institution engaged in teaching, training, research and service. Being a specialized Arab League organization, the Academy is a multifaceted institution with a diversity of functions serving a multinational body of students.

The Academy educates, trains and qualifies students in all the disciplines, sciences and technologies related to the various aspects of the maritime transport industry; and offers degrees and professional programs in nautical studies, marine engineering studies, electronics and computer studies, maritime transport studies, seamen's training and marine catering.

The Academy through its 'open-channels' system of education offers Bachelor's, Diploma's and Professional Certificate's programs as well as higher upgrading Competency Certificate's Courses for maritime transport and sea personnel students in a wide and almost comprehensive range of career specializations.

The Academy also provides extensive and intensive in-service executive management, economics, technology and engineering training and specialized professional programs, seminars and courses, as well as maritime research and consultation workshops for the maritime public sector corporations and private organizations in Egypt and elsewhere; either independently or under the aegis of national, regional and international agencies.

AMTA - thus - distinctively exemplifies a unique institution in which integration and comprehensiveness of maritime education and training is constantly combined with the tireless endeavour towards the promotion and advancement of the high quality of education and the meaningful and productive preparation of prospective and servicing personnel in the varied fields of the maritime transport career.

1. Simulation : On Board Ship

1.1 Master's Post

Starting to think how to manage and maintain AMTA'S new campus in ABU-QUIR, within the context of a maritime academy, our attention was primarily geared towards, the maritime and consequently the ship: how to handle, guide, direct and steer, from the point of view of control and maintenance in the full meaning of the issue at stake.

The bridge (Master's Post) is the heart of the ship and the post where the Master or his deputy (Duty Officer) carry on all activities to direct and control the ship around the clock, in harbours or at sea, under all circumstances either favorable or not, in all weather conditions, calm or rough sea, separately or within a convoy.

Taking a decision, especially in a short period of time, or in critical situations, a wide range of Data Base is needed as a main tool to fullfil the job accurately or even satisfactorily.

1.2 Ship's Data

- This includes charactaristics, drawings, history life, when and where built, major and even minor repairs and refittings, all safety equipment available, instructions, responsibilities, fire fighting, damage control, rescue, salvage, medical services, abondoning ship instructions... etc.

- What types of steering gears, instruments, sets, radars installed, stores, types , status and function, fresh water, ballast, oil, fuel, tanks, conventional cargo, storage or containers, separation rules...etc.

- Ships cerw, specilizations, jobs, duties, cababilities, degree of training as a team or as indviduals...etc.

1.3 Media Data

- All types of navigation aids available in the area of ship's location: either local or international - how to make use of them in all situations (fog as an example). Prohibted and dangerous areas for navigation either deep sea or territorial waters.

- Full detailed information [Special pilot books covering all the world] about the areas in which the ship is proceeding, where to and where from, harbour facilities, sea side status, provisions and details even habits of port of call population...etc.

1.4 Engine control room

- Main assistant post to Bridge, dealing with all engine details (main and auxilary) type and class of engines, gauges, manometers, repeaters, type and classification of store areas, tanks and limitations affecting ship's bouyancy and stability.

- All kinds of routine, when, how and by whom, all drawings, sketches, plans, technical data about ship, history life, spare parts, refittings, dock yard schedule and procedures of inspections and routines. All certificates dealing with licenses given by insurance, classification and registeration authorities and sociaties.

1.5 Conclusion

Having this wide range of Data Base, with the aid of reliable means of communication (internal and external) assuring transmission and reception of meaningfull reports, messages continously and in time, the Master, or around the clock Watch Keeper, can have clear accurate, precise background in order to take correct, proper, adequate actions or decisions without any hesitation especially within the limited time given in a critical situation, bearing in mind all the time safety considerations (lives, ship, cargo if any).

2. Abu-Quir Campus

Coming back to AMTA's campus overlooking the Mediterranean, it is 52.4 acres in Abu-Quir town eastward of Alexandria, 10.5 Km from AMTA's other campus in Miami, and 27 km. from city center.

2.1 Components

- Four Education Buildings
- Four Dormatories
- Library
- Cadet's Command Building
- Recreation and in-door games Building
- Administration Building
- Playgrounds - Swimming Pool (under construction)

- Mosque
- Mess and Kitchen
- Central Workshop
- Seaman's training Center and workshops
- Fire Fighting Department
- Pollution Center
- Sailing Club and Boat Hangars
- Marina
- Stores
- Student Services Complex: (Bank, post, telephone, mini-market, bookshop,..etc.

2.2 *Plan*

The Management and Maintenance of campus is envisaged as follows >

Administrator : Master
Campus : The ship
Campus Control center : Master's Post
Central Workshop : Engine Control room
Zones, Posts, Mobilegroups : Ship's Divisions, Posts, Mobile groups.

3. Campus Management

3.1 Campus Control Center

Three years ago, AMTA established a site group, to follow up construction stages from the point of view of AMTA'S needs and to collect actual details of site layout, buildings, drawings, surface and underland nets, green areas, landscape, streets, and passages.

During the various phases of finishing the buildings, we started to specify each building and collect all detailed information, data specifications,(lobbies, corridors, offices, administrative areas, lounges, dining areas, storage areas, laboratories, classrooms, stairways , stairwells, restrooms etc), dimensions, classes, type and material of finish etc). We then sorted out this information into several forms according to its similarity and here below we can cite example of data collection relevant to education buildings.

Form 1

Description, dimensions, floors, rooms, stairs, stores, restrooms types and no: of windows, doors, floors, walls...etc.

Form 2

Usage indication numbering of rooms stating its class or type, dimension planned functions (class room, labs, staff-rooms etc.)

Form 3

All surfaces and type of areas and material used: i,e.:

7000 M^2 glass,
2000 M^2 wooden floor,
17000 M^2 oil paint walls,
9000 M^2 fibre and rubber tiles...etc.

Form 4

No: type and specifications of switchoards, nets, telephones, broadcast, fire alarms, water lines, sanateries, sewage pipes, manholes, light posts..etc.

Form 5

All inventories, planned to be installed in rooms, labs, corridors shown according to standard type and use, i.e:

500 student chair type 00254
60 P.C. in 3 computer labs
50 Black boards type 00132
20 Firefighting extinguishers 5 gallons...etc.

3.2 Basic Requirements

Knowing civil details of buildings, its contents, nets, and available acess, areas and bearing in mind AMTA'S policy of optimum use, we started to make use of all forms available as a term of reference to our needs in such a way to provide for:

- Full description of work and maintenance requirements

- Manpower skills, type and number
- Time alloted to each function
- Budget needed and cash flow, timing allocations
- Tools, instruments, vechiles
- Standing orders, instructions. forms
- Suggested systems for preventive maintenance, repairs, corrective actions

The experience gained in utilizing the data base in the example cited above led to its full implementation in other buildings within the campus.

3.3 System Analysis

- We collected all AMTA's implemented systems and procedures for all types of maintenance and repairs either inhouse or through contractors.
- Acting as an external audit we obtained the feedback from users to specify, the advantages and or deficiencies.
- We, then, started to collect and summarise the experience of adjacent military premises, campuses and regional universities.
- We, also visited U.S. Merchant Marine Academy, at king's Point.
- University of New York
- Maritime College U.S.A.
- Marine Technical College
- Tokyo University of Mercantile Marine Japan
- Marseille Maritime College
- Philadelphia University, U.S.A

Our visits were fruitful and helpful to a great extent in exhcanging views and experience.

3.4 Work Control Center

Location of Campus Administrator and his staff around the clock, We started to create a Control and maintenance center provided with all means of communcation, internally and externally on-line with Abu-Quir Town Authorities.

A wide range of Data Base was established consisting of all major and minor details for management control, maintenance and repair.

- All standing orders, regulations, routine (Education andStudent Commandment).

- Important events and notes of Arab League, countries or other Countries Sponsoring cadets.
- P.C. to install all data
- Maps and Charts of Alexandria and Abu-Quir
- All services offered by Alexandria Governorate
- Main service facilities (names, adresses and telphone numbers).
- Full details of site layout, landscape, buildings, net works,
- Green areas, passages, streets by distance and positions.
- All details of existing workshops and facilities.
- All key personnel and how to call them in case of emergency
- Transportation policy and system
- Organization chart and job describption
- Weather conditions and prevailing winds (marina)

So, the campus heart was fully provided with all, required and useful information ready to start.

3.5 Central Workshop

This reports directly to campus Administrator

1- Laison groups: mobile teams to carry out preventive maintenance routines, repairs, minor corrections up to level I in their zones.

2- Body of workshop: Specialized crafts to carry out complicated repairs and corrections up to level II. May dispatch an emergency team to area pending on situation or importance.

3- Existing training workshops: and of more skilled and experienced crafts which carry out corrections and repairs up to level III.

4- Through AMTA's Logistic system repairs more than level III are carried out by specialized contractors (national or foreign) or through replacement, procedures , according to set norms.

3.6 Zone Posts

The campus is divided into zones A.B.C.D within walking distances. Each zone has its Base Station (Maintenance post) provided with reliable means of communication (Twoway radio, telephone, messenger, memo) to recive problem reports in time, either written or verbal and instantly pass directions to team personnel to start work.

- Maintenance Post (M.P.) is clearly notified to all users of zone, in addition to other areas.
- M.P. laison officer in change (contact person) supervisor, responsible for all activities and discipline.
- Zone group (team); carpenters, plumbers electricians, sometimes mechanics, civil labourers, according to the nature of work needed. number of craftsmen, capabilities, skills, is according to zone status, features, role and complexity of selection for important and critical areas.
- Each M.P is equipped with work bench, suitable tools, some shelves, lamps, fuses, storage cabinets...etc. For the kitchen, diesel generators, boat hanger, narrow specialist teams are set according to narrow specifications and sophistication of skills needed. Each M.P. has standing orders covering all transactions, all activities, procedures to fulfill their jobs according to standardnorms as well their limitions and range of responsibility, technical regulations, safety publications and warnings, concrete and specific job descriptions.
- Laison officer, better familiar with area system, personnel attitudes, routines users, can easily understand the demands. Also knows well all routines needed in his area. P.M. routines and corrective maintenance, minor repairs, history of zone, weak points...etc. Critical and important parts, stable units and current problems. Having sense of pride and good public relations and mutual co-operation with others.

3.7 Special Groups

Handle inspection and routine tasks according to schedule, either corrective or preventive maintenance, knows clearly how to handle problems within the shortest route, such as Diesel engines, firefighting equipment, marine pollution, boat maintenance.

3.8 Mobile Groups

- Craftsmen provided with hand driven carts with fibre glass ladder, to carry on all electrical repairs and maintenance, to light posts and manholes.
- Craftsmen provided with hand driven carts and all appropriate tools for water pipes repairs maintenance and manholes up to the level of reconstruction in case of accidents.

- Same for sewage system
- Physical plant groups are provided with all approprite gardening equipment and tools to carry on all green areas handlings in addition to responsibility of all indoor shade plants and flowers.

3.9 Problem Reports

According to standing orders and regulations, (well understood and clarified) to all users on campus the laison officer in charge recieves reports of problems, either verbally or through written forms, and according to needed correction he directs or dispatchs craftsmen of special groups to the area of action supplemented with his directives and instructions.

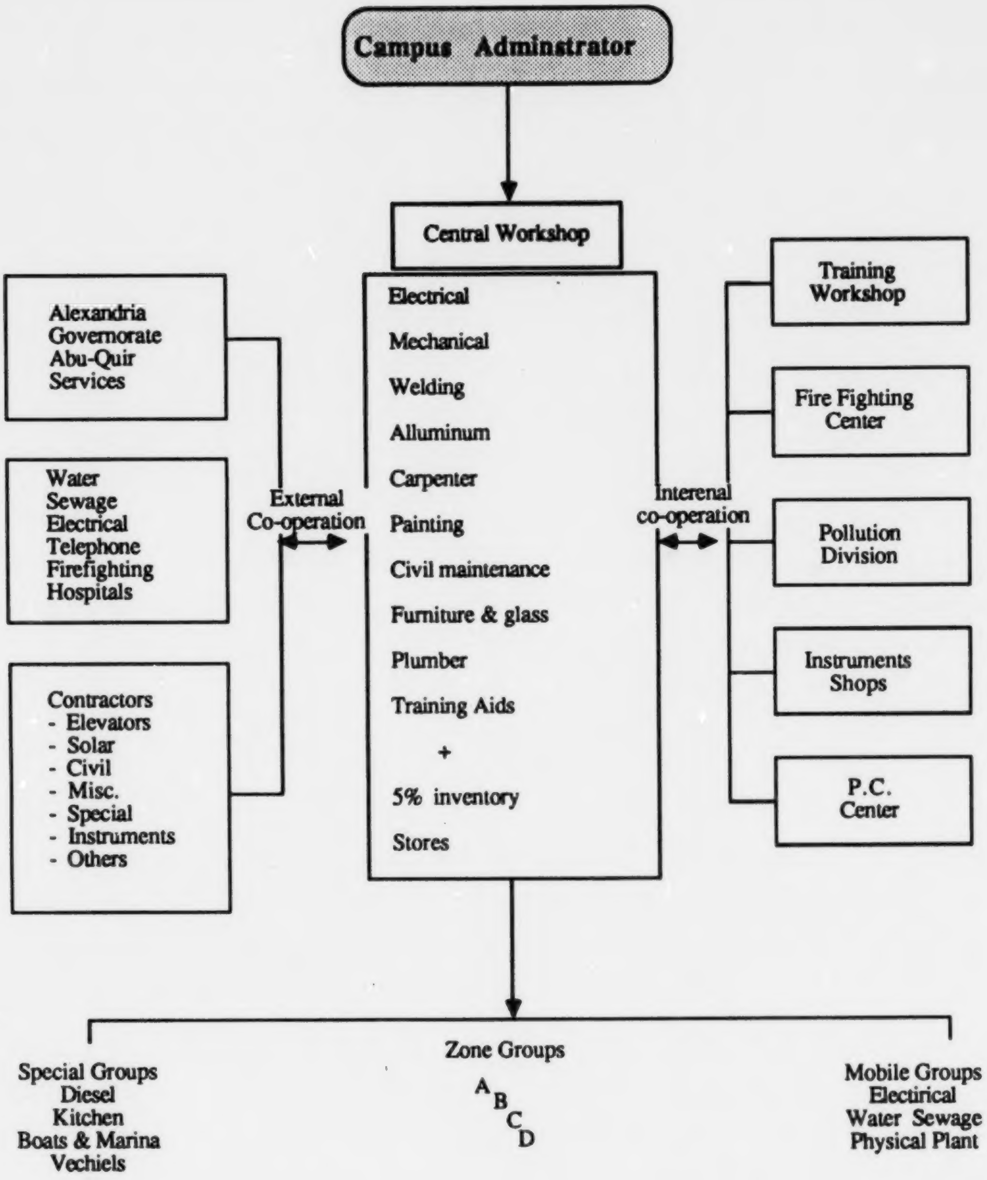
He may transfer work orders to the central workshop, with accurate description of problem, what skills required, action needed or supplies acquisition if any stating what deadlines fixed. He is also ready to answer any enquiries thus giving full clear image of the situation at stake orally or in writing.

Quick clear precise handling of problems especially in critical situation is needed with calm nerves for correct counteractions.

Continuous informing and reporting to higher authorities on the status of work done and situations encountered are of prime importance to decision - making circles.

Conclusion

The above is a factual descriptive report of a model of campus management implemented in AMTA, Alexandria Egypt. Simulation based on ship systems reflects the climate of activities run in the campus However, the system - as such - can be applied effeciently in any other educational campus.


Campus Adminstrator
Central Workshop
Electrical
Mechanical
Welding
Alluminum
Carpenter
Painting
Civil maintenance
Furniture & glass
Plumber
Training Aids
+
5% inventory
Stores
Alexandria
Governorate
Abu-Quir
Services
Water
Sewage
Electrical
Telephone
Firefighting
Hospitals
Contractors
- Elevators
- Solar
- Civil
- Misc.
- Special
- Instruments
- Others
External
Co-operation
Interenal
co-operation
Training
Workshop
Fire Fighting
Center
Pollution
Division
Instruments
Shops
P.C.
Center
Special Groups
Diesel
Kitchen
Boats & Marina
Vechiels
Zone Groups
A
B
C
D
Mobile Groups
Electirical
Water Sewage
Physical Plant

Thermal Energy Storage for the Large and Small Campus

Glen L. Carver
Assistant Director of Physical Plant
Arizona State University

It is not my purpose to extol the benefits of a thermal energy storage system for cooling or to infer that a unit will have a satisfactory cost/benefit ratio for every campus. I will attempt to present to you with some simplicity the concept of the units we are installing at the Arizona State University Main and West Campuses.

There are many factors to be considered, first the utility must be a "partner" in this joint venture, reference to Arizona Public Service (APS) will identify the utility company supplying electrical power to both campuses.

To determine the feasibility required extensive preliminary study. Initial cost of installation, amount of incentive payment from the utility to be applied to various sizes of units, and off-peak rate structure were considered prior to presenting the analysis to the governing authority. Other items of concern were location, visual impact (if any), funding, payback, legal considerations concerning contracting with the utility and our commitment to reduce consumption during peak hours were critical issues. Cogeneration was also an option that was considered.

For presentation purposes, I will concentrate on the unit at the main campus where we have 6,553,678 sq. ft. of space and 18,000 tons of central cooling capacity. However, to show the feasibility of a small campus installation on a smaller scale, a brief summary of the West Campus comprising 175,000 sq. ft. of space with a Central Plant that has 2000 tons of cooling capacity will be exhibited. The performance and operating specifications and the attached statistical data is a summary of the thermal energy storage system at Arizona State University.

1. Performance Specification

A. Overview - The Thermal Energy Storage (TES) system is designed to reduce peak campus electrical demand during high demand afternoon periods (on-peak) by shifting chilled water production to (off-peak) lower demand evening periods. Chilled water can be produced and stored during the off-peak periods to supply a portion of the next day's campus cooling requirement. As a result, fewer chillers are required during on-peak periods to satisfy campus cooling loads.

The system consists of a six-cell compartmentalized underground tank for storage, each cell equally sized, with four variable frequency driven pumps, integral piping, valves and tunnel for integration into the existing campus central chilled water system. The empty tank concept is utilized; i.e., the equivalent of five cells will contain the useable storage volume. The system volume will be 5,560,000 gallons, storing 54,000 ton-hrs of chilled water. The projected demand shift for this installation is 6827 KW for the capacities stated. Design parameters are listed on Attachment A.

The storage tank is located under the athletic fields north of the new Student Recreation Complex and south of the University Bookstore. A tunnel from the storage tank location to the Central Plant provides for routing of supply and return water piping.

Central Plant equipment affected will include a transfer of operation of Central Plant chillers to off-peak periods to limit on-peak chiller operation. Use of the new primary/secondary pumping system allows the secondary system to continue to follow the campus load. The primary system allows the chillers to operate separately to charge the Thermal Energy Storage System during off-peak hours, continue to serve evening campus loads and to parallel the Thermal Storage System during the on-peak periods. As a result, fewer chillers will be required during on-peak, and more at off-peak to charge the system. The advantages of this system are 1) increased on-peak cooling capacity, and 2) reduced on-peak electric demand.

The Central Plant chilled water system consists of 18,000 tons of nominal chiller capacity with nine (9) chillers, (18) 30hp primary pumps and (2) 50hp primary pumps and (3) 200hp (1) 250hp and (4) 450hp secondary pumps.

B. Tank Design - The chilled water storage tank is compartmentalized into six separate, equal volume cells. Initially, only five of the cells are filled with water with one cell remaining empty. To charge or discharge the tank, water is drawn out of a "full" cell and returned to the "empty" cell. As the cell that was empty becomes full and the cell that was full becomes empty, the valving arrangement at the tank is changed. Water is drawn out of a new "full" cell and returned to the cell that was emptied during the previous cycle. This sequence is continued until all five cells have been discharged or until the cooling requirement from the thermal storage tank has been met.

The water flow rates during storage tank charging and discharging are controlled by four 125hp, 3750 gpm variable speed pumps. The speed of the pumps, in turn, is controlled based on the current campus KW and the TES control mode as discussed in the Operating Specifications.

C. Interface with Existing Central Plant Equipment - Chilled water connections between the storage tank and the existing campus chilled water systems are located at the discharge of the primary chilled water loops for the east and west chiller systems and at the secondary chilled water return header for the east side. (Because the east and west secondary returns are interconnected, only one secondary return connection is required.)

In charging mode, chilled water leaving the chillers in the primary loops at 42 degrees fahrenheit is used to fill successive "empty" cells in the storage tank. The 56 degree fahrenheit water returning from the storage tank is reinjected into the secondary chilled water return header. This additional chilled water load is seen by the existing chiller control system as additional "campus" cooling load. As a result, additional chiller capacity is brought on-line as required by the existing chiller control system to meet the storage tank charging load. The magnitude of the charging load is determined by the flow rates into and out of the tank which are determined by the campus KW and the TES control mode as discussed in the Operating Specification.

In the discharge mode, flow directions into and out of the storage tank are reversed. As a result, chilled water from the storage tank at 42 degrees is injected into the primary chilled water loop(s) and 56 degree secondary return water is returned to successive "empty" cells at the storage tank. The increased primary flow is sensed by the existing chiller control system which responds by unloading and ultimately shutting down chillers as required to match combined chiller and storage tank chilled water supply flow rate to actual campus load. The flow rates into and out of the storage tank are controlled based on the current campus KW and control mode as discussed in the Operating Specification.

2. Operating Specification

A. Overview - The mode of operation of the system will be to maintain total campus electric load below a specified target demand during peak demand periods. The most critical time will be the peak cooling season between May and October when full utilization of the Thermal Storage System may occur on a daily weekday basis. The storage system will be charged on weekends and during off-peak periods until the system is fully charged or during the off-peak season until enough cooling capacity has been stored to meet the entire on-peak cooling demand for the next day; and will be utilized (discharged) as necessary whenever the campus demand would, in absence of the TES system, have been above the target demand during on-peak periods. Four 125hp variable speed pumps will draw the flow required from the five (5) fully charged cells at the start of each day. At the end of the on-peak period, the five (5) cells should be full of 56 degree water, rather than the 42 degree water that the cells started with.

B. Operation Schedule - The control strategies determine the operating schedule of the ASU Thermal Energy Storage system. A "target" KW is established for the TES computer controls system for that day. The target KW is the lowest peak campus demand that can be maintained by discharging the TES during the on-peak demand period without running out of TES capacity. The target KW is determined based on historical data and current and anticipated conditions. Historical data includes previous weather and campus thermal and electrical load profiles. Current and anticipated data includes the amount of energy stored in the thermal storage tank; the day of the week, month and year; the day status, i.e., weekday, weekend or holiday; the school session; and anticipated weather conditions.

Once the target KW is established, the TES system operates as follows: When campus demand reaches the target KW starting on or after 11 a.m., as the campus demand so dictates, the control system operates in discharge mode and begins to pump 42 degree water from the storage tank into the primary chilled water loop. As discussed previously, this unloads and/or shuts down chillers with a resulting reduction in electrical demand. The discharge rate of the TES is controlled to maintain the campus electrical demand at the current target demand, i.e., as campus demand increases, discharge flow rate is increased, as campus demand begins to decrease (early evening), discharge flow rate is decreased. When campus demand has decreased below the target kW and the TES discharge rate has been reduced to minimum, the TES system is shut down.

Once the campus demand decreases to ten percent below the target KW or at 9 p.m., the control system switches the TES system into charge mode and the system begins to recharge as described in the Performance Specification. As currently running chillers are loaded up and additional chillers are brought on to recharge the tank, campus electrical demand increases. The rate of TES system recharge is therefore regulated by chilled water flow rate to and from the storage tank to maintain the campus demand at less than twice the on-peak demand, i.e., as campus demand decreases, charging is increased; should campus demand begin to increase, charging would decrease. The charging cycle continues until all five cells in the TES tanks are completely filled with 42 degrees chilled water or enough cells are filled to meet the anticipated demands of the next day.

C. Projected Hourly Electric Load Profiles - Annual electric load data both before and after the utilization of the TES system have been developed. Included in these data are the components of electric loads based on metered data available and projected campus loads. Because of the volume of data, this information was furnished in computer diskette format. Since the demand shift goal is to reduce the peak demand on the peak electrical demand day of the year, a 48-hour profile of the before and after case is shown on the attached series of graphs, and summarized of the projected maximum demand shift table.

D. Maintenance Schedule - With the empty tank design, total system breakdown or outage is virtually eliminated; there are no internal tank components which require routine maintenance. The only tank component which will require inspection is the waterproof liner, which can be done on a cell-by-cell basis. This inspection will be performed during the low cooling season (November - February) annually or as often as necessary when reduced storage capacity will satisfy campus cooling needs. (Reduced capacity means that the useful volume of four or less cells are needed rather than the design capacity of five cells.) Liner replacement is not anticipated until the system is 8-10 years old.

Other system components consist of tank valves and pumps. Routine maintenance again will be performed during the off-season as necessary. Pump redundancy protects against a variable frequency drive or pump failure - no more than three of the four VFD pumps are required at the anticipated peak system flow rate.

The only other component is the 30" diameter distribution and interconnection piping system. Our history at ASU in distribution system reliability is excellent; there is no record of a distribution system component failure, only scheduled outages for valve replacement and additional building tie-ins, and never at peak cooling periods.

In summary, all regularly scheduled maintenance will occur between November and February when the campus electric demand is lowest, and a total system outage is not necessary to perform any regularly scheduled maintenance.

ATTACHMENT A
Arizona State University
Thermal Energy Storage System
Design Parameters

Electric Rate Schedule	E35
Tank Size (useful million gallons)	5.56
Tank Size (ton hrs.)	54,000
Tank Height (ft)	21
Tank Width (ft)	200
Tank Length (ft)	257
Number of Cells	6
Projected Demand Shift*(KW)	6827
Minimum Storage Temperature Degrees Fahrenheit	42
Maximum Storage Temperature Degrees Fahrenheit	56
Maximum Charge/Discharge Flow rate+(gpm)	15,000
Maximum Charge/Discharge Flow rate+(tons)	8750
Maximum TES Pump KW+	500
Probable Maximum Discharge Flow rate*(gpm)	12,860
Probable Maximum Discharge Flow rate*(tons)	7500
Probable Maximum TES Pump KW*	405

* On peak demand day based on comparison with current primary/secondary pumping system @ 8 degrees fahrenheit temperature rise in secondary loop.

+ Maximum design

ATTACHMENT B
ARIZONA STATE UNIVERSITY
THERMAL ENERGY STORAGE SYSTEM

ASU Main Campus - 6,553,478 Square Feet

University funds	$4,500,000
Utility incentive payment	850,000
Total investment	$5,080,000

Electric Rate -

E34	.06647
E35 (off peak)	.024407

Estimated savings per year	$1,150,000
Payback	4 years

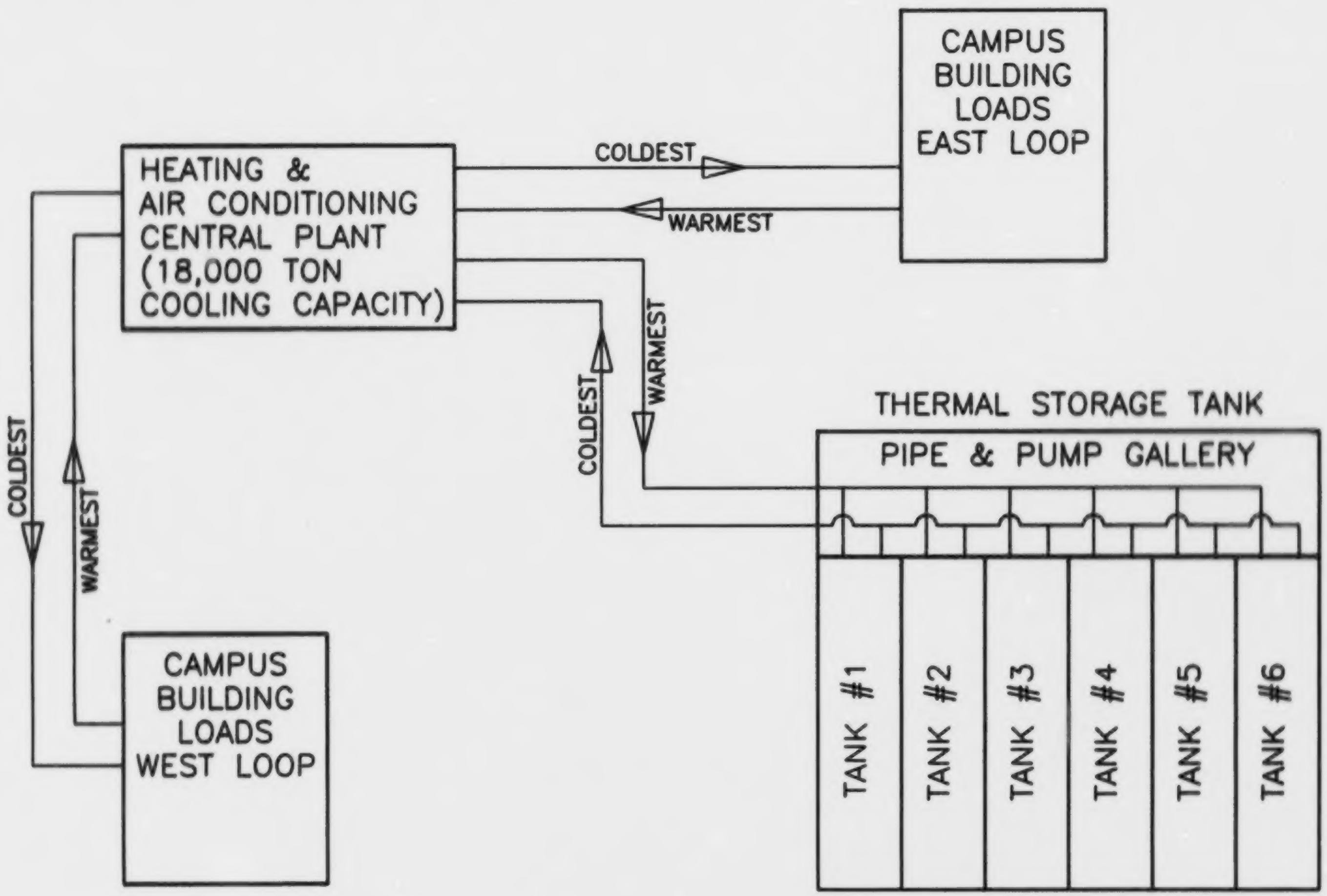
ASU West Campus - 174,000 Square Feet

University funds	$ 625,000
Utility incentive payment	75,000
Total investment	$ 700,000

Electric rate -

E34	.06647
E35 (off peak)	.024407

Estimated savings per year	$ 169,844
Payback	4 years


CAMPUS BUILDING LOADS EAST LOOP
HEATING & AIR CONDITIONING CENTRAL PLANT (18,000 TON COOLING CAPACITY)
COLDEST
WARMEST
COLDEST
WARMEST
COLDEST
WARMEST
THERMAL STORAGE TANK
PIPE & PUMP GALLERY
TANK #1
TANK #2
TANK #3
TANK #4
TANK #5
TANK #6
CAMPUS BUILDING LOADS WEST LOOP

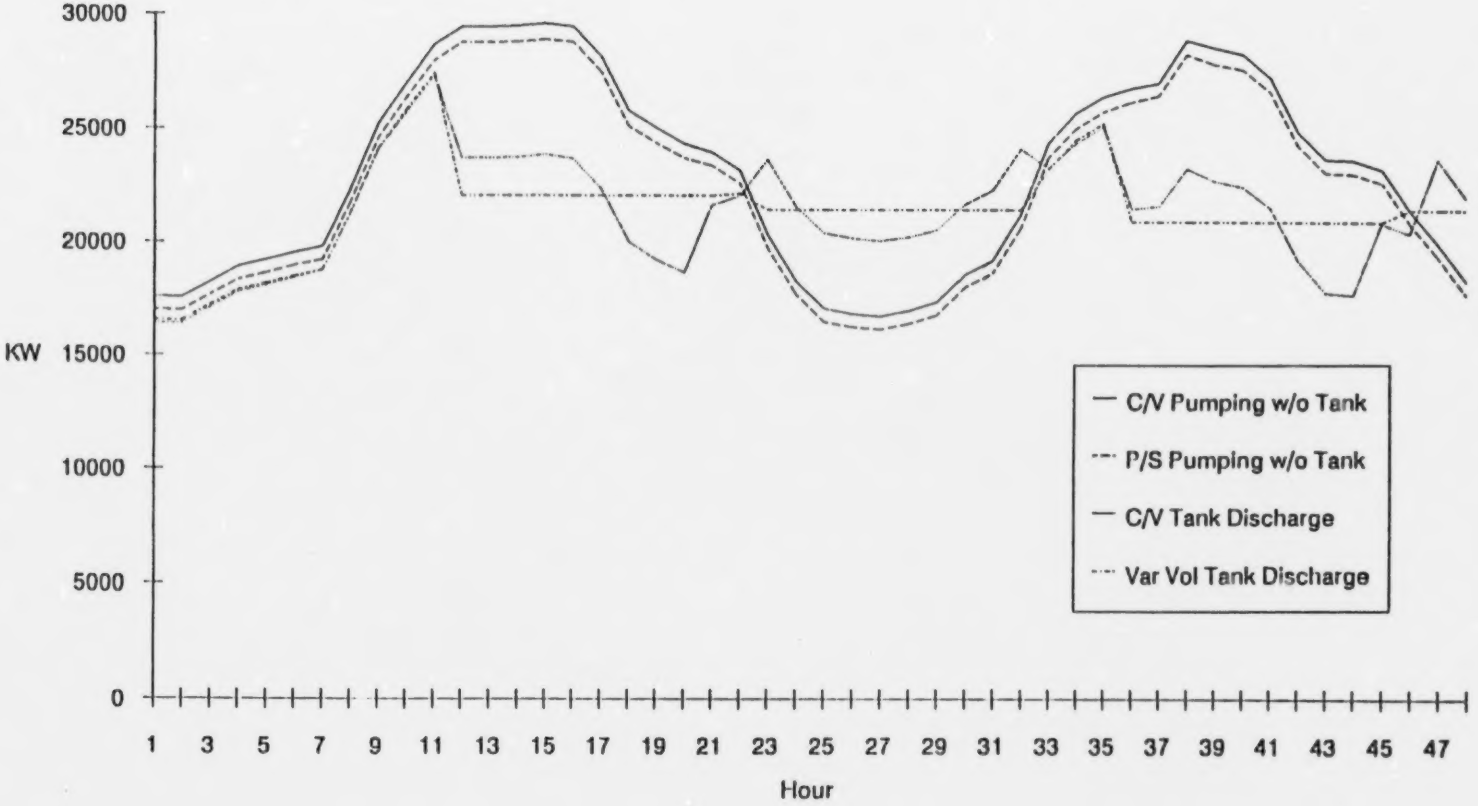
250

251

ASU COOLING SYSTEM SCHEMATIC DIAGRAM

NOT TO SCALE

ARIZONA STATE UNIVERSTIY
Thermal Storage Analysis
54,000 Ton-Hour Tank (E-35 Rate)
August 24-25, 1990 (Projected)

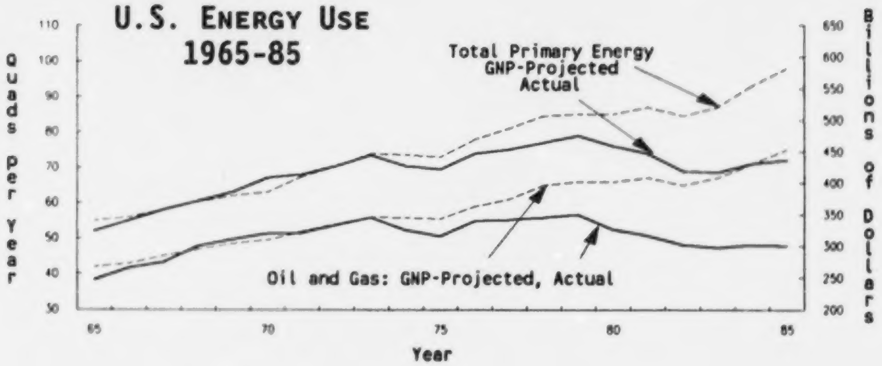


Electrical Energy Management Through Lighting Retrofits

Paul D. Black, P.E.
Senior Engineer, Energy Conservation Unit
University of California at Berkeley

Seventeen years ago energy conservation was born. Has it had an impact? Between the mid-seventies and the mid-eighties:

1. The U.S. did not increase energy consumption while seeing a 35 percent rise in the Gross National Product.
2. New building technologies and better energy management trimmed $45 billion from the U.S. energy bill.
3. If all the nation's refrigerators were as inefficient as 1975 models, they would require twenty additional 1000-megawatt power plants.
4. Fuel demand dropped by 1.2 million barrels per day (bpd) while we added 20 million households and 15 billion square feet of commercial and residential floor space. This is two-thirds the output of the Alaska pipeline. (1.9 million bpd total output)
5. All forms of conservation saved the U.S. $150 billion per year or the equivalent of the federal budget deficit.



Is conservation still an important issue today? Lower oil prices and reasonably stable electric rates may lead you to believe that conservation is no longer a high priority. Don't be misled. U.S. oil production peaked in 1970 and world oil production will begin declining early in the next century. Despite the success of conservation to date, there are estimates that we could save an additional $200 billion per year. Conservation can be used to supply new electricity needs rather than building costly power plants. This is recognized by many including the utility industry as evidenced by the large number of conservation rebate programs offered by utility companies today. Formerly, utilities practiced Supply Side Management. They planned to add generating capacity at a then typical rate of 7 percent per year to meet anticipated loads. Today, utilities are using Demand Side Management, meeting new loads with conservation. The impetus for this change in the power industry comes from:

1. Cost overruns in power plant construction. New plants now cost $1500 to $2000 per kw.
2. Increased interest costs for plant construction.
3. Lower fuel costs mean large, efficient plants are not mandatory.
4. Unstable regulation environment means plant cost overruns may not be allowed into the rate base.
5. Other power suppliers (cogeneration) now bring competition to the power industry.

Conservation can reduce electrical growth, but inevitably some new power plants will have to be constructed, undoubtedly leading to higher electric rates. Also, these plants will be either coal or nuclear, each with it's own environmental issues. Recently constructed nuclear plants have taken over 14 years from approval through start-up. Energy conservation is an important tool which a facility manager can use to hold down operating costs, while, in effect, providing an environmentally benign source of power.

What is electrical energy management ? Electrical energy management is the process of planning and implementing a program to reduce operating costs (or lower the rate of increase) by reducing electrical energy use and demand. The resulting cost avoidance gives a manager the means to redirect funds to other areas of physical plant operations. There are other reasons for energy management programs other than reducing facility operating costs. To name a few:

1. Eliminate, postpone, or reduce facility capacity upgrades.
2. Improve the environment by reducing fossil fuel emissions from electrical generating plants.
3. Avoid new power plant construction by maintaining utility company capacity margins.
4. Receive income from utility company rebate programs.
5. Lower customer recharge rates.

Now that you're convinced that Electrical Energy Management is a good idea, how can you implement a program? Our approach at the University of California at Berkeley (Cal) has been a comprehensive program containing the following elements: (1) Energy Policy, (2) Publicity, (3) Conservation Projects.

Energy Policy

The decisions made today regarding new building construction will impact a facility's operating costs even fifty to a hundred years from now. Making new buildings more efficient can slow the growth in demand. California's conservation efforts between 1975 and 1985 reduced annual growth from a predicted 5 percent to only 2 percent, thus avoiding the construction of 15,000 megawatts or 15 large power plants.

Energy efficiency in new buildings can be implemented at a lower cost than existing buildings, since in new construction it is the differential cost of the conservation measure, not the total cost, that is used in a cost-benefit analysis. For example, the cost of specifying high efficiency motors is only the additional cost of the motor versus a standard design. The labor cost to install the motor has to be in the project regardless of which motor is used.

There are many areas of building construction which can be addressed with an energy efficiency policy:

motors
glazing
boilers & furnaces
chillers
refrigeration
lighting fixtures
lighting controls
daylighting
HVAC system
HVAC controls
insulation
weather-stripping
appliances

Publicity

If you charge your tenants for energy use then you probably don't need energy conservation publicity. Their monthly bill will keep them informed. However, for those facilities that don't directly charge for energy, a moderate amount of information can keep tenants informed of what energy is costing and advise them on ways they can assist in holding down these costs. Newsletters, posters, stickers, energy hotlines, and seminars can help maintain building occupants as responsible energy users.

Even seventeen years after conservation began, there are still people who believe it is better to leave lights on all day than to turn them off. Publicity programs can convince them to turn off their lights. Personal computers have proliferated in the last several years. A survey at Cal showed that the number of pc's increased 8 times between 1984 and 1989, and now account for 3 percent of the campus electrical use. Many people feel that pc's should be left running 24 hours a day and it may be difficult to convince them otherwise. But a publicity program is relatively inexpensive and can convince many to reduce energy use while improving communications at any facility.

Conservation Projects

There are, of course, a multitude of energy conservation measures available today. I feel that the following measures are three of the best - they are cost effective, applicable to almost all facilities, and proven performers:

1. Energy Management Systems
2. Thermal Energy Storage
3. Lighting Retrofits

Energy Management Control Systems

Computer based energy management control systems (EMCS) are practical and cost effective for most medium to large facilities. Centralized equipment scheduling, flexible control strategies and accurate setpoint tracking with direct digital control provide efficient operation of HVAC systems. Lighting systems can also be controlled, thereby centralizing control of a good portion of a facility's electrical load.

EMCS systems have evolved to where the hardware is more distributed, more reliable, and less expensive then early systems. Software is also more reliable and more flexible than former systems.

Secondary benefits of these systems are: (1) faster diagnosing of HVAC problems, (2) detailed data on actual system operation (current and history), (3) easy rescheduling for special events, (4) easy adjustment and special strategies for control setpoints.

Thermal Energy Storage

Air conditioning accounts for one-third of the 500 gigawatt peak demand in the United States. Time of day rate structures have increased air conditioning costs at a faster pace than average electricity rates. This is due to the fact that maximum air conditioning loads are coincident with peak demand periods, and utility demand side management is attempting to reduce peak demand growth by charging more during peak period hours. For example, a recent study at Cal showed that the resulting electric rate for a typical ac system is 13 cents per kwh while the campus average rate was only 6 cents per kwh. Thus, it can be seen that any measure to reduce cooling loads may save substantially more than previously realized.

Thermal energy storage (TES) does not reduce energy use, but shifts cooling equipment electrical loads to the less expensive off peak rate periods. During the peak demand periods, typically summer afternoons, the cooling is derived from stored ice or chilled water. In the same study as mentioned above, a TES system operated at an average rate of only 5 1/2 cents per kwh.

Rebate programs for TES are offered by 45-50 utility companies in the United States. They recognize that it has the greatest potential to shave the peak on their demand curve and help avoid future power plant construction. Also, TES doesn't remove the load (and the revenue), it moves the load to off-peak hours, thus, utility companies are still profiting from the energy sales.

The shorter the duration of a cooling load, the better the potential for TES. For example, if you had a building with a one hour load of 1000 tons, you would require a 1000 ton chiller and 1000 ton-hours of cooling energy. A TES system can provide the same 1000 ton-hours with a 60 ton chiller (assuming 18 hours of off-peak operation) and cost much less to operate. There are also some secondary benefits of TES:

1. The smaller refrigeration equipment means lower maintenance costs and lower replacement costs and less CFCs.
2. The electrical system capacity requirement is reduced.
3. The air side of the HVAC system can be reduced if lower supply air temperatures are used.
4. Energy losses from poor maintenance will show up (and hopefully be corrected) because the storage capacity will not be adequate to meet the demand.

There are now 6000-7000 thermal storage systems operating in the United States. Most of these have been installed in the last 3-5 years. What is now a $150 million a year industry is expected to grow to a $2 billion industry by 1998.

Lighting Retrofits

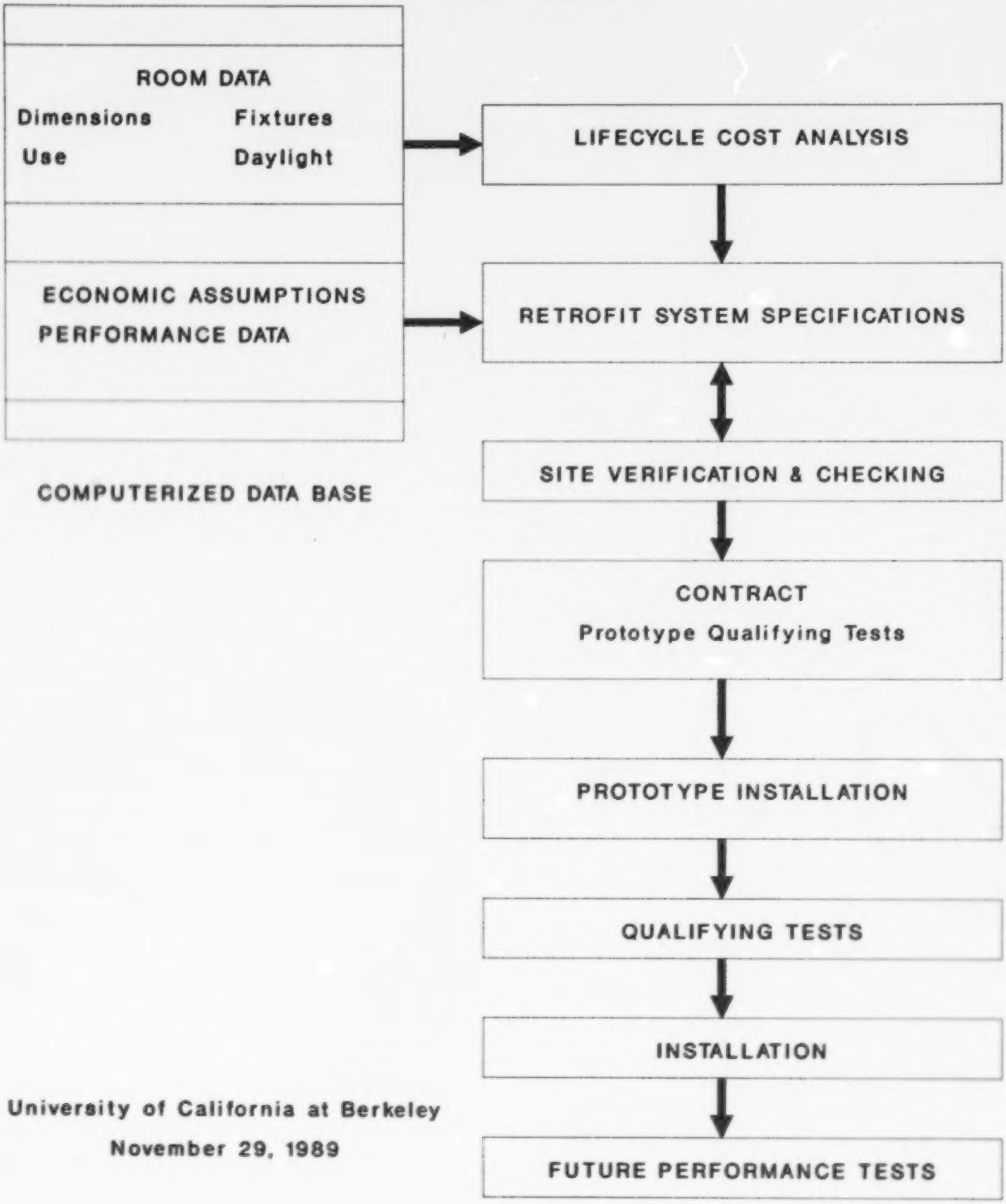
Lighting retrofits offer simple, reliable and widely applicable methods for reducing electrical energy use and peak period demand. Despite this, many facilities have not yet implemented these measures. Expanding on this topic I will cover three areas: (1) A System, (2) Methods, (3) Our Experiences.

A System

By system I mean a procedure to implement lighting conservation measures from surveying rooms to completing the installation. The Lighting Improvement Program at Cal has been underway since 1986. When it's completed in 1991 we will have modified fixtures in buildings totalling over 6 million square feet. The flow chart on the following page shows how our lighting program is structured.

LIGHTING EFFICIENCY IMPROVEMENT PROGRAM

FLOW CHART



ROOM DATA

Dimensions Fixtures

Use Daylight

ECONOMIC ASSUMPTIONS

PERFORMANCE DATA

COMPUTERIZED DATA BASE

LIFECYCLE COST ANALYSIS

RETROFIT SYSTEM SPECIFICATIONS

SITE VERIFICATION & CHECKING

CONTRACT

Prototype Qualifying Tests

PROTOTYPE INSTALLATION

QUALIFYING TESTS

INSTALLATION

FUTURE PERFORMANCE TESTS

University of California at Berkeley

November 29, 1989

Methods

Since Energy = Power X Time, lighting retrofits must either reduce power or reduce operating time. The measures used to accomplish this are as follows:

Power Reductions:
high frequency ballasts
incandescent replacement
optical reflectors with delamping
delamping
partial light output ballasts
daylight dimming controls

Time Reductions:
occupancy sensor controls
photosensor controls
time clocks
time delay switches

Our Experiences at Cal

One of the key aspects of our program is that fluorescent fixture retrofits are selected based on an area's illuminance requirements. The existing illuminance is estimated for clean, newly lamped fixtures by computer analysis, then the retrofit is selected which will most closely meet the target illuminance. The types of retrofits relative to the existing light levels of a space are shown below.

```
Space Overlit---------------------------Space Underlit
^-----^
Delamp
      ^------------^
     Reflector & Delamp
                 ^---------^
                Partial Light Output Ballasts
                         ^----------------^
                        Full Light Output Ballasts
                                          ^----------^
                                       Enhanced Lamps &
                                                Ballasts
```

Concerns about **high frequency ballasts** have not been about energy efficiency or product cost but rather about reliability. Early models certainly indicated that reliability was poor, and many facilities prudently tried them only briefly, or never tried them at all.

Our recent experience has shown that the reliability of these ballasts has increased dramatically since the early years of their production. High frequency ballasts are used in all of our fluorescent fixture retrofits with over 40,000 installed to date. The following table shows the failure rates from our experience through the fall of 1989.

Years/ Manufacturer	Total Quantity	Failure Rates, % High	Low	Average
1982-83 3 Brands	1,000	-	-	10-15%
1986-89				
A	17,145	2.7	0.3	1.0
B	11,248	1.4	0.01	0.5
C	4,168	10.5	4.3	6.3

Manufacturer "C" in this table did show higher failure rates, but this product was a more complex, dimmable unit. This product is no longer in production.

The cost effectiveness of replacing ballasts is, of course, dependent on many factors such as input power of the existing system, operating hours, and electric rates. The data below shows a typical cost/benefit for high frequency ballast replacement. The retrofit case includes the cost of cleaning, relamping and purchasing and installing the new ballast. The attrition case is replacing ballasts only when they fail, the cost being the added cost of a high frequency ballast over a conventional one. The electric rates shown account for time of day billing and are used in all subsequent cost/benefit tables.

Annual Operating Hours	Input Power watts Old	New	Energy Savings $	Retrofit Cost, $	Payback Period
Retrofit:					
3000	80	60	4.80	35.00	7.3 years
8000	80	60	9.60	35.00	3.6
Attrition:					
3000	80	60	4.80	15.00	3.1
8000	80	60	9.60	15.00	1.6

Electricity Rates: 3000 hr/yr - 0.08
($ per kwh) 8000 hr/yr - 0.06

Partial light output ballasts are high frequency ballasts which have been factory modified to give 70 percent or 85 percent of full light output with a proportional reduction in the input power requirement. They are useful in applications where some reduction in illuminance is possible, but delamping or reflector retrofits are not feasible. Typical cost/benefit is shown below.

Annual Operating Hours	Input Power watts Old	Input Power watts New	Energy Savings $	Retrofit Cost, $	Payback Period
85% Light Output:					
3000	80	51	6.96	35.00	5.0 years
8000	80	51	13.92	35.00	2.5
70% Light Output:					
3000	80	42	9.12	35.00	3.8
8000	80	42	18.24	35.00	1.9

Future generations of electronic high frequency ballasts will offer higher efficiency, better electrical characteristics, dimming features and, hopefully, continued reliability. Some estimates predict that these ballasts will gain 50 percent of the ballast market by 1995.

Specular reflectors, unlike high frequency ballasts, can not be used in all fluorescent fixtures for a number of reasons. First, physical characteristics of the fixture may make it impossible to retrofit a specular reflector. Second, it may be desirable to keep the light distribution of the existing fixture. For example, uplight and sidelight may be distribution features which would be eliminated by a reflector retrofit. Third, light levels and uniformity requirements may preclude the use of reflectors.

Generally, a specular reflector and two lamps will provide the light output of a three lamp fixture while making the light distribution slightly more narrow. If a four lamp fixture is changed to two lamps and a reflector, there will be a 25 to 35 percent decrease in illuminance compared to a clean, newly lamped existing fixture. Therefore, areas selected must be able to tolerate this reduction in light levels. However, relative performance varies depending on the existing fixture - a reflector in a strip fixture will do better, while one in a porcelain surfaced fixture worse.

There are many materials used for specular reflectors, the most common being:

anodized aluminum
enhanced anodized aluminum (dielectric coating)
silver film on aluminum

Material preference should be based on consideration of cost, desired performance, durability, and the reputation of the vendor who supplies the product. We have used all three materials at Cal and have installed over 14,000 reflectors over the last three years with very few problems. This is about one third of all retrofitted fixtures. We've used reflectors in offices, classrooms, libraries, laboratories, and corridors.

Light level reductions can be minimized if inefficient lenses or louvers are replaced in conjunction with the reflector installation. Attention should be paid to potential glare problems when replacing lenses, especially where video display terminals are used.

Economic data for typical reflector retrofits are shown in the table below. These retrofits include the cost of a high frequency ballast.

Annual Operating Hours	Input Power watts Old	Input Power watts New	Energy Savings $	Retrofit Cost, $	Payback Period
4 Lamp to 2 Lamp:					
3000	160	60	24.00	80.00	3.3 years
8000	160	60	48.00	80.00	1.7
3 Lamp to 2 Lamp:					
3000	120	60	14.40	80.00	5.6
8000	120	60	28.80	80.00	2.8
2 Lamp to 1 Lamp:					
3000	80	30	12.00	60.00	5.0
8000	80	30	24.00	60.00	2.5

Replacing incandescent fixtures remains an excellent retrofit because of the large wattage reduction possible and the reduction in required maintenance. A 60 watt fluorescent fixture will provide more light than a 200 watt incandescent unit and the lamps will burn ten times as long. Compact fluorescents and new high pressure sodium lamps offer solutions to retrofitting downlight fixtures. Even globe type fixtures can usually be fitted with a compact fluorescent unit. The table below shows economic data for some typical incandescent retrofits.

Annual Operating Hours	Input Power watts Old	Input Power watts New	Energy Savings $	Retrofit Cost, $	Payback Period
Fixture Replacement:					
3000	200	60	33.60	100.00	3.0 years
8000	200	60	67.20	100.00	1.5
Compact Fluorescent:					
3000	60	15	10.80	30.00	2.8
8000	60	15	21.60	30.00	1.4

Daylight dimming controls reduce the light output (and input power) to fluorescent fixtures in response to daylight entering a space from windows or skylights. They offer great potential for energy savings, especially since the power reductions will coincide with utility peak demand billing periods. A study at Cal showed that energy use decreased by 30 percent from the installation of daylight dimming controls.

There are a number of systems available, some only for core and coil ballasts, some only for high frequency ballasts. Unfortunately, the high cost of high frequency dimming systems makes them cost effective only in new construction. Upcoming generations of high frequency ballasts will hopefully make retrofit attractive as well. The cost effectiveness of dimming systems can vary widely depending on the daylight characteristics of the area to be controlled and the dimming system selected. More time is required to analyze daylight dimming measures than any other lighting retrofit. Computer software is available which greatly helps with this complex analysis.

Occupancy sensor lighting controls have been in use for ten years, and are highly reliable and cost effective in many applications. The most common types of sensors are ultrasonic and infrared. The best applications for these controls are classrooms, conference rooms, break rooms, multi-occupant occupant offices, and restrooms. Occupants of these areas tend to not turn off lights when they are the last to leave. How much can be saved in a particular area is, of course, dependent on how frequently, if at all, the lights are currently turned off by occupants or custodial staff.

Metering a classroom lighting system at Cal showed that operating time was reduced by 20 to 40 percent with the addition of an occupancy sensor control. Economic data from this study is shown below. This installation was relatively complex, so better paybacks can be achieved in more typical installations.

Input Power watts	Annual Oper. Hours		Energy Savings $	Retrofit Cost, $	Payback Period
	Old	New			
Occupancy Controls:					
480	3373	2273	31.68	170.00	5.4 years

Time clocks, photosensor switches, and time delay switches all work on reducing the "time" portion of the energy equation. Turning off a lighting load is the best conservation strategy if it's feasible.

Inexpensive photosensor switches are commonly used for outdoor lighting, but they can also be used for daylit indoor areas, such as, lobbies, corridors, and any area where the switching will not disturb the occupants.

After being switched on, a time delay switch counts down a set amount of time then turns off the lights. They can be used in lightly used warehouse areas, restrooms and lunchrooms and can be installed for much less than an occupancy sensor control.

Hazardous Waste

One issue which should not be overlooked in starting a lighting retrofit program is hazardous wastes. Pursuant to the Toxic Substances Control Act of 1976, a facility is required to treat ballasts not labelled "NO PCBs" as hazardous waste. We provide a training manual and list of rules and procedures to contractors, who have their workers read the material and acknowledge this by signature.

Unlabelled ballasts are removed from buildings by the contractor, and packed in drums in a licensed hazardous waste transfer site on campus. Campus Health & Safety staff arrange for shipment of the containers by a licensed hauler to an approved dump site.

The contractors also receive training on how to deal with non-labelled ballasts that are leaking. Special cleaning procedures and notification of safety personnel and occupants are used in these situations.

Recently, spent fluorescent lamps have come to be treated as hazardous wastes under sections 66669(b) & 66680(d) of the California Administrative Code. Our contractors store the used lamps in cartons in designated transfer locations on campus. A licensed recycler then removes the material for processing, in which clean glass is eventually produced and sold to lamp manufacturers. Until a process is developed and approved for separating recyclable materials from the remaining toxic powder, the material (greatly reduced in volume from the original lamps) is disposed of at an appropriate licensed dump by the recycler. The present cost to dispose of lamps is about $0.40 per tube.

Summary

The Lighting Efficiency Program at Cal has reduced electrical consumption in buildings from 5 to 36 percent. The graphs on the following pages show the results of our lighting program in four campus buildings. The buildings shown have the following types of room use:

Building	Room Use
Moffitt Library	library, classrooms, offices
Boalt Hall	library, classrooms, offices
Campbell Hall	offices
Latimer Hall	laboratories, offices

A lighting improvement program is one of many opportunities for the facility manager to reduce electrical energy consumption.

Utility company rebate programs may help you fund the modifications, thereby reducing the payback period. Lighting in particular offers many reliable and cost effective options. If you have not yet embarked on a lighting efficiency improvement program, now is the time to get started. Future electrical growth will force new power plant construction leading to higher electricity costs.

References

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R. Abesamis, P. Black, and J. Kessel, "Field Experience With High-Frequency Ballasts", IEEE Annual Conference Record, Part 2, 1989.

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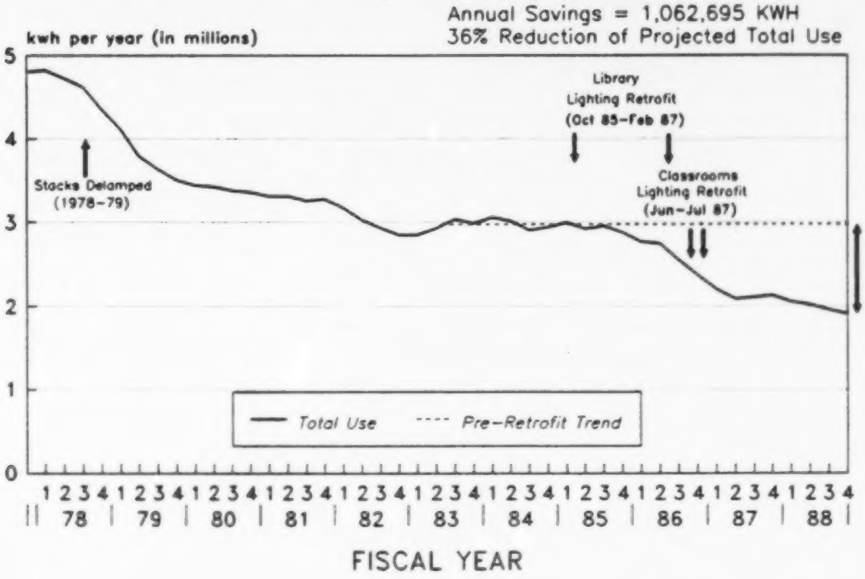
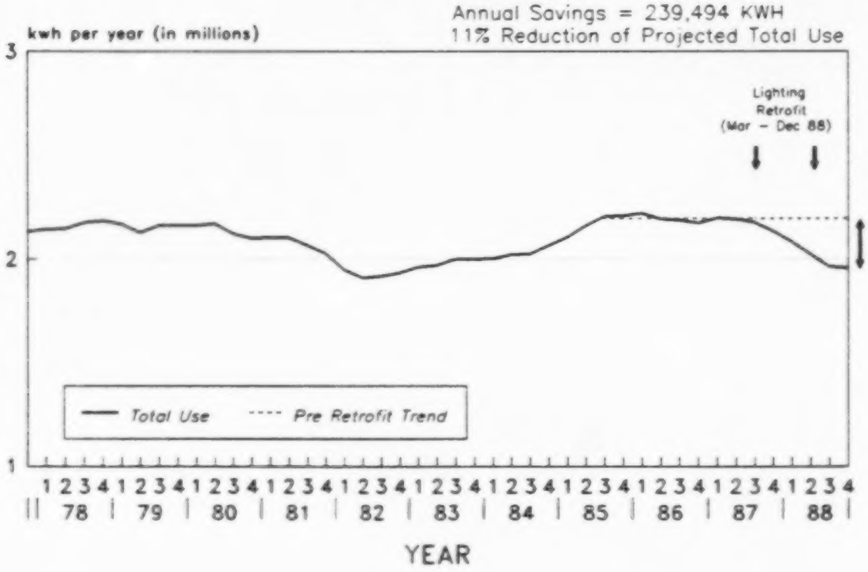
Electrical Reductions Through Lighting Retrofits

Moffitt Library and Classrooms



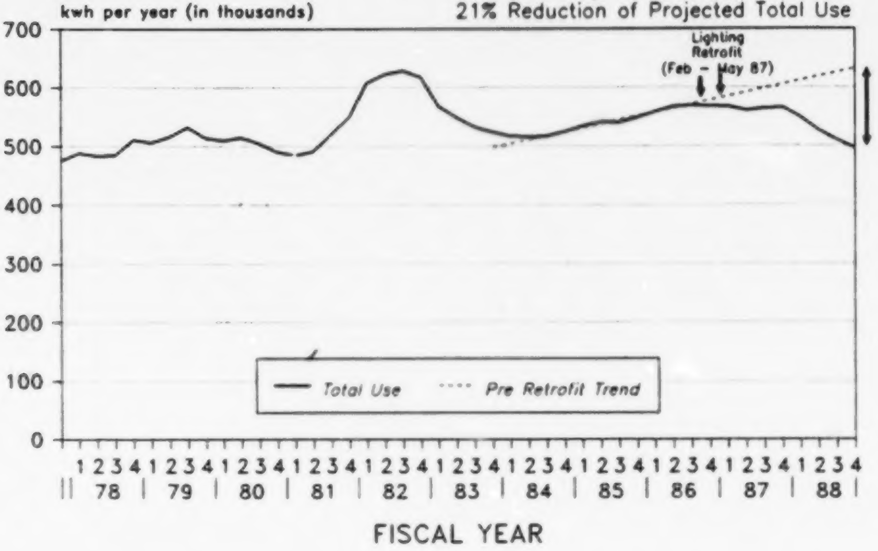
Boalt Hall



Electrical Reductions Through Lighting Retrofits

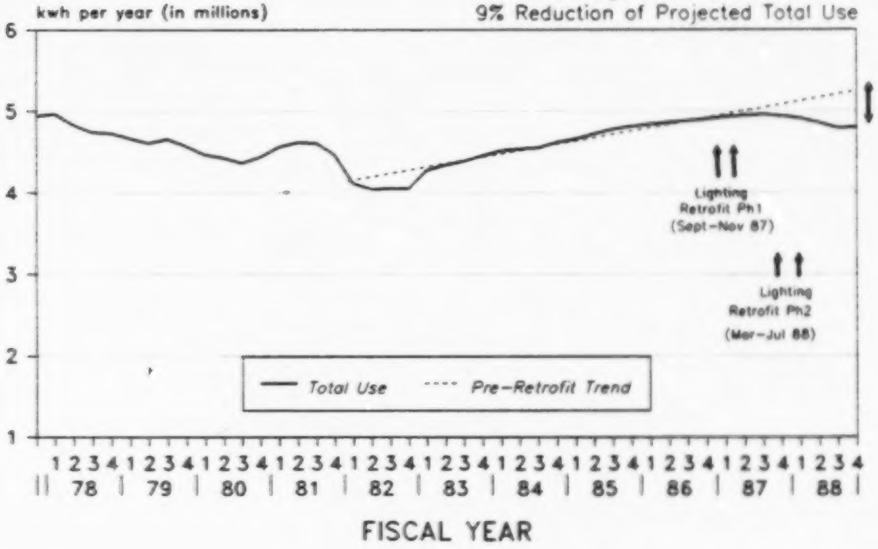
Campbell Hall

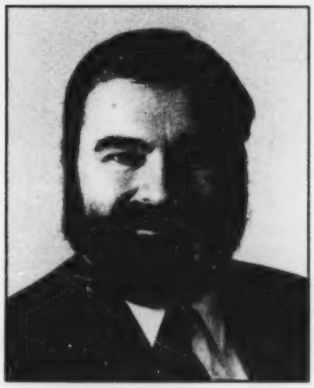
Annual Savings = 134,408 kwh
21% Reduction of Projected Total Use



Latimer Hall

Annual Savings=452,189 KWH
9% Reduction of Projected Total Use





Capital Renewal/Deferred Maintenance

Frank J. Kuszpa Jr.
Assistant Vice President for Operations
University of Hartford

Capital Renewal/Deferred Maintenance is a major concern on most college and university campuses. It is an issue that is not going to go away. But, what is the actual definition of Capital Renewal and Deferred Maintenance? Are they one and the same? An appropriate definition for Deferred Maintenance is simply those maintenance items which were not accomplished on our campuses to keep the buildings and grounds in good physical condition, but were intentionally or unintentionally deferred to some future year. The problem of deferring to some future year is that unless that future year brings additional resources the problem is only compounded. The other significant problem we all know is that as we defer this maintenance to future years we will not only pay a higher price due to inflationary pressures, but often we pay a greater price due to secondary damage which has occurred and which could have been avoided if the maintenance had been done at the appropriate time.

Capital Renewal is a different concept. Capital Renewal is the upgrading of a space, building, or a portion of the grounds, to current standards and needs. An example of Capital Renewal would be if in a laboratory we had no deferred maintenance, but the educational mission could not take place as effectively as it should because the lab did not have the proper electrical voltages for today's modern equipment.

Therefore there is a distinction between Capital Renewal, the up dating of facilities to current needs, and the Deferred Maintenance, where repairs were not made on a timely basis.

Now there is a definite link between Capital Renewal and Deferred Maintenance. Usually when you go through the process of Capital Renewal you inherently wipe out most Deferred Maintenance. So, that in changing the electrical system within the lab for Capital Renewal purposes - to bring it to current standards - any Deferred Maintenance in the former component is gone, since it no longer exists.

The second important link is the root cause of the need for Capital Renewal and the source of Deferred Maintenance; that root cause is the lack of funding. On an ideal campus, funds would be available to perform whatever maintenance was needed and funds would be available as technologies and teaching methods change to accommodate those needs. Throughout this paper I will simply use CRDM to refer to this issue because they are integrally linked.

If we are to be proactive, we should include CRDM in our mission statement even if we do not have sufficient funding to begin a major effort, I think we must at least recognize the issue and put together presentations requesting funding. Therefore the starting place would be in the mission statement.

What does the administration know about Capital Renewal and Deferred Maintenance? We have a responsibility in the facilities management arena to make the administration aware of exposures and potential exposures. CRDM is an exposure we must bring forward. It is an exposure we must work on and be prepared to move forward to control and reduce. It is not enough to say: I don't have the money or I don't have the time. Unfortunately, if you continue to find yourself using those statements one day an out of state "expert" will come riding in on a white horse to save your campus. He will take the president, business officer, or someone else in administration on a tour and point out the Deferred Maintenance and all the problems which we all know exist on our campus. Suddenly, the university sees this as an issue, and are asking you why you did not bring this issue forward. You are now in an reactionary mode and depending on the consultant this reactionary mode will not only continue but may spread to other areas of your operation. Let me assure you this is not in your best interest.

A System

One approach would be to create a CRDM information database for your particular campus. This database will both quantify and qualify the extent of the CRDM issue. For maximum benefit the system must be interactive allowing projects to be added, deleted, or modified. While a printed report sitting on a shelf is useful, it is dated before you receive it, and is only a snapshot in time. The recommendation to have an interactive database that can be used on a daily basis would require a computerized system for effectiveness. Those of you who are perhaps not as familiar with computers, or who may have had a bad experience, you need not be alarmed - computers do not necessarily mean big dollars or an expert to run them .

The database systems are becoming more and more user-friendly. As a matter of fact one of the major criteria for choosing a database system is to choose a user-friendly program if you are unfamiliar with computers, and do not want to devote large amount of time to learning. To help you to envision what a database system is, one should visualize a set of index cards. If I asked you to track the various individual projects on index cards, you would have no problem doing that. On the card you could write the name of the project, the cost, location; you could put a priority on a project, a description or remark about the project. A host of individual parameters about that given project could be written on an index card. From that point you would write index cards for each of the projects; put the index cards in a box in alphabetical order or maybe you would group by individual buildings on campus. You would have someway of sorting out these cards for easy retrieval.

That is a database system. When we computerize it, the computers memory is nothing more than a stack of index cards sitting inside the computer box. And, instead of having to flip through individual cards, you would ask the computer to show you a project in a particular building and the computer will go through the cards for you to show you this individual project. The tremendous advantage of a computerized system is that the computer can rapidly sort through the cards to find what you are looking for, even if you did not file them in that order or in the case of the computer, input them in that order. The computer also has an advantage of printing out and making lists for you. When it makes these lists it can print all or some of the information on the card. And again, it can very quickly sort and rearrange these cards to put them in a different order. It can even print individual groupings. For example, it may print all projects less than five thousand dollars; all projects for a certain building; all projects that have to do with roofs.

So, you see, the computerized database is actually somewhat simplistic in concept. Programs today have become very user-friendly so you will not have to spend days learning a computer program. Also the computer hardware to accomplish all of this is relatively inexpensive. It most certainly can be done on a personal computer, and programs are available for all types and manufacturers of computers.

The most important thing you will need to do is to establish the framework that you are going to use for your database system. What are the categories that you wish to include in this database? This step is very important because you will be spending an enormous amount of time initially auditing the campus and continue on a regular basis. You want to be sure to find all the parameters for each and every project that you add to your list. First, what information is necessary further down the road when you begin to implement these projects? Of course the project identification and where the item is located is important, but is something like a serial number important? It may or may not be. Next, think of how you are going to use all this data as information for yourself and for others in reports. You might want to put a dean's name as a category; if the project occurs in his or her area; so that later you can generate reports to the deans. You might want to include a project manager slot which initially would be blank but later as projects are assigned you could put a name in there. You might want to put a status section so that status and historical reports can be generated. Try to envision all the different reports that might happen.

We have developed a system at the University of Hartford. It is not perfect, other institutions might certainly do it differently. In your institution, it should be customized for the needs of your particular campus environment.

The first item is to assign a project identification number. This might be an alphanumeric code or simply a number. This identification number can also be put on work orders, purchase orders, invoices, and any other information that could benefit from such coding. The second item is a short description of the project. Long descriptions should be on backup reports; the description on the database system should be as short as possible. Next is the location. The location is usually thought of as a building name. However we must not forget about the roads, sidewalks, and lawns that comprise the grounds of the campus. These areas are just as important to Deferred Maintenance and from a visibility viewpoint be right at the top of the list. Also included in our system as a location is the infrastructure of utilities that run between our buildings. Then the system divides the buildings and grounds into components and building systems. APPA members and consultants with a background in Navy facility management often use a breakdown of Primary Structure, Secondary Structure, Service Systems, and Safety Standards. At the University of Hartford we developed a system comprised of

Primary Components, Major Systems, and Subsystems.

Some of the Primary Components for buildings considered in our system are: Exterior, Mechanical Systems, Electrical Systems, Interiors, Furnishings, and Safety. For the Grounds location, a Primary Component would be roads. The CRDM system breaks down the Primary Component into its Major Systems. Examples of Major Systems of the Exterior Primary Component would be roofs, penetrations, and walls. The Major Systems are further broken down into Subsystems. Subsystems for roofs might include membranes, flashing, and expansion joints.

Another category in the CRDM system is the mission. I have developed a Mission Statement for our department that details what our department is charged to accomplish. On this database there is a category called Primary Mission and a category called a Secondary Mission. For example, one mission is the quality of student life so that when I come across a project that would improve the quality of student life, that mission category is put on our database for the particular project. The reason that I have a category called Secondary Mission is because many times a project will cover more than one mission. For example, if we do something in student life that also helps preserve the assets of the institution I would put that under both missions of student life and asset preservation. This makes a very useful document for a presentation later as well as a good sorting document when the occasion arises. If suddenly it becomes a mandate to do something about declining enrollments then you might want to pull out all the projects that are under the Mission Student Life. As you can perhaps now visualize this system can be expanded beyond the Capital Renewal/Deferred Maintenance category and can include all projects one can envision.

Typical reports generated are: Location report, Primary Component report, Major System report, Mission report, Priority sort, Deferred Maintenance report, and Space Type report. The above reports are a few of the many reports easily generated on this database system. This database system can be the basis for, and transferred into, another database system. Such databases could be an active project list, a special capital project list, a completed project list, etc.. In these other databases additional categories may be added.

One of the important things to note here is to develop a list of key words, and have those key words readily available during the audit. This is best accomplished by having an input form available, and a cookbook for the auditor to follow. The same word should be used all the time. This is because computers are very exact instruments. Later if you type in the word 'roof' it will pull out all the projects that are in the Major System category, roof. It will not include a project that is listed under roofs, in the plural form.

Getting the Information

An audit of Capital Renewal and Deferred Maintenance needs is an essential beginning in the process of bringing your facilities up to par. The audit could potentially have many uses. There are many ways to perform an audit depending on the dollars and time available.

If in the beginning you need to arrive at a number of the magnitude of the CRDM number very quickly, you could take the Association of Physical Plant Administrators (APPA) booklet entitled the "Ticking Time Bomb". In this book you will find colleges and universities grouped according to their Carniege Classification and the average amount of Deferred Maintenance found in each of these classifications. While this is probably the least exact method it will arrive at a number for your campus in the shortest amount of time. You could also use a little bit of judgement based on your experience whether your campus might have more or less Deferred Maintenance than the average. But always caution others when you use this method that it was merely if your campus was average, here is the amount of the Deferred Maintenance that could be expected. That number alone will be an eye-opener for administration and for governing boards who may be unaware of the significant exposure for this problem.

There are other techniques that might work out to provide a number based on your campus. Harvey Kaiser in his facilities audit workbook has a formula method by which you take some data on the campus; age of buildings, types of buildings; and you walk through his workbook putting in the various numbers; performing the various inspection routines and data gathering and you come up with again an estimate of the CRDM needs for your campus. This method is a dramatic leap from the prior method in that it is based on your campus and it does begin to take into account issues of age and condition of actual facilities. This method however does not perform the real in-depth detail audit of looking at individual projects, and documenting and estimating those projects. However, in consideration of time spent and the desirability for a first estimate it can provide a real starting point.

Another method one might look at is to try to estimate the equilibrium budget for your campus and look at the historical funding for your department against that budget. Now this difference will show the Deferred Maintenance needs. This method will not show Capital Renewal needs and I would assume that on most campuses accurate data for a long period of time might be very difficult to find. However, the important advantage of this technique is when it can be used in combination with other techniques. If the business officer, other administration, or your governing board suddenly seems not to understand how Deferred Maintenance can be such a large number, perhaps choosing a few current years; the last three years, the last five years, the last ten years, and performing this technique showing the gap between the required funding and funds actually made available will begin to demonstrate to them the kind of erosion that has and perhaps is continuing to occur on your campus.

The above techniques will all be approximations. Approximations are important for getting attention, for defining a general magnitude of a problem, and in determining the priority that should be placed on CRDM. To really begin to know with any thoroughness the real CRDM needs and to effectively begin to address this problem requires a detailed audit. If you were to say to someone in administration that a detailed audit must be performed, they would probably agree and tell you to go out and perform such an audit. However, as a Facilities Manager you know that a detailed audit is not at all an easy task. It is extremely time consuming and if consultants are used - extremely expensive.

However, this is perhaps the most important step in tackling the CRDM issue. Now what is meant by detailed audit? A detailed audit literally means that you look at every single building, every single component of that building. You look at the surroundings of the building, the campus infrastructure, and carefully inspect and document deficiencies. Then put dollar estimates on those deficiencies. The detailed audit will require close inspection and inspection by individuals knowledgeable in each particular facet of the facilities. Therefore, one individual most likely would not do the best job performing the audit entirely on his or her own. One in-house method that has been used was taking supervisors within the physical plant and have them go out and perform the audit. The electrical supervisor would go out and look at all his area. This has particular value in that he knows the physical plant, and knows the history of chronic problems that have occurred.

While this method will probably produce very good results, again the magnitude of the work load is enormous. We would be talking about an electrical foreman on a campus, let's say the million and a half square feet, spending about six weeks auditing, documenting, estimating, inspecting. The same would be true for each of the trades. It would be difficult to imagine that any one of us in physical plant would have the time to spare individuals to go out for such a time consuming task. However, it has been done and it is part of the commitment to the CRDM problem.

The audit done by an in-house team can be spread out over a long period of time to encompass all four weather seasons in your geographic area. It would be easier to detect heating problems and infiltration problems in the winter in the northern climates than it would in the summer. Each of the seasons probably helps to identify problems and allows systems to be taken apart for more inspection or to be watched in operation. An outside consultant would be performing an audit on your campus for a limited period of time in most cases, and you would only have a snap shot version during a particular season. One of course could always bring back a consultant for very brief follow-up visits during certain seasons if it was thought to be advantageous. But, again you would want to consider this in the overall planning.

For a consultant to perform an audit the firm should have a variety of individuals inspecting your campus. Again, you want people with background and experience in particular systems they are inspecting. An outside auditor will also take a long time to really look at your campus and the old adage of "You get what you pay for" is very much in effect.

The cost of a detailed audit will run any where from six to ten cents per square foot in 1990 prices. Therefore you can see that on a one million square foot campus, eighty thousand dollars is what one might expect to pay for a consultant to perform the audit. One might question should that amount of money should be spent on merely auditing and without any tangible results in terms of repair to brick and mortar? That's a valid question and one we must ask. Depending on where we are in the CRDM process may give us a clue for an answer. It may also be a function of finances of a campus and who is asking the question. If the governing board has funds and wants to go ahead and do a detailed audit I think that would be an excellent idea. On the other hand, a physical plant director who has no money in his budget and might spend all his discretionary funds for an audit - then perhaps that might not be the best tactic. Somehow, the director must invest in the future and define the problem in sufficient detail to stimulate action.

Be aware of consultants whose costs seem low. Instead of the eighty thousand dollars for a million square foot campus, they might tell you they could do it for thirty. But buyer beware, what are you going to get for the thirty thousand. The consultant might have a very strong sales approach and might be very convincing. But demand that if you think you found such a bargain that you understand exactly what you will get for that money: How many people will be involved this process, what is their expertise and experience, how long will they spend on campus, what kind of report will you get? This basic information should be part of any contract.

For example, there are consultants who will gather three or four people, who have expertise in some areas, but will be auditing areas where they do not have experience. They will spend a couple of days on your campus and then go away. Back in the home office a fancy report will be put together. This fancy report when it is complete looks like they might have performed a detailed audit. It certainly looks like there was tons of data gathered. In reality what may very well have occurred is that the thirty thousand dollar audit was perhaps worth ten or fifteen thousand. A data jockey manipulated, added numbers where ever he felt there were holes, and a given body of data was sorted in a dozen different ways and was presented as many different exhibits.

One really needs to understand what you are getting from such a report and to be sure that this money is well spent. Perhaps for your purposes it may be worth while, although again you certainly would want to pay the true value of the report and not some over inflated price that the market might bear. There are many firms that do a good job and they each have their own system for reviewing the data. Ask about the verification of data and the mechanics of report generation.

When an architectural firm of high regard performs an audit on your campus and then subcontract out the engineering portion to others there are other cautions. If the subcontracting is done with an engineering firm of high quality that they routinely do business and have used in the past for this service then the product will most likely be very good. On the other hand, if the engineering firm is chosen on the basis of cost then there is a high probability that the end product will not be good. I know of a very good architectural firm that won an award to perform a Deferred Maintenance study and they did an excellent job on the architectural elements; tremendous detail, good estimates, and very good information on how to repair situations encountered. The architects bid out for an engineering firm to come out to the campus and perform the audit on the mechanical and electrical systems. This audit which was part of the total Deferred Maintenance audit was a disaster. There was a chiller that had not run for twelve years, packed solid with rust, and one of the power plant people had painted it just because it was such an eye sore. It was completely bypassed and the only reason it was sitting in the building was that the university did not want to incur the expense to have it removed. The consultants reported that the chiller was in very good condition. It did need minor control repairs that he had actual dollar estimates on. He felt that it was a viable piece of equipment that did not have much in the way of Deferred Maintenance.

Of much more importance than you might realize is the system approach that will be used: How are they going to categorize the areas they are looking at and when this report is all done, how useful is this report going to be other than a few presentations? Is it presented in a format so that it can be a document that is used for many years to come? Is it computerized for ease of data manipulation? Is the computerized information going to be actually given to you or will this consultant hold this as proprietary information? Finally, do you have the computer hardware and software to take advantage of this? Here is where your interactive system is key.

Perhaps your institution already had some form of auditing done. It would certainly be very useful to look at these audits in the context of the new system: Can information be extracted from these former audits, updated, and put into the system?

Other reports to look at are not only formal facility assessment programs but other studies that might have had comments in them. For example, those of you who have participated in many of the federal energy programs and had a technical assistant audit done; those reports many times would contain items that should be done but were not included in the earlier program because of inadequate pay back or other such issues. Additions to buildings, accreditations visits, all these reports might have some section on the facilities where conditions were noted and information might be extracted to be included in your system.

As mentioned earlier, one the largest areas not to be overlooked is the area of the in-house staff. Having your staff aware of your system and what you are trying to accomplish from the very beginning will be useful. They may be able to give you additional input and critique the system itself. They are another set of eyes and ears roaming the campus, noting conditions and projects to be included. If one can get the staff excited about this project perhaps some staff-time can be set aside just for the purposes of auditing to develop projects to be included in your system. An example would be that one of my staff members came forward to request that we do something about the floors in one of our dining facilities. While I knew the particular floor and knew that it was in need, I also knew that there were other floors on campus that had a need. So I assigned the staff member who was quite knowledgeable about floors to go out and spend half a day looking at the floors in our major corridors, building main entrances, and a few of the specialized areas such as dining facilities, and auditoriums. With all the projects at hand, we now had a complete range of projects and were able to make a determination given the limited sources available; should we do the dining facility? By breaking the campus into smaller pieces either by building, by mission, or any other given parameter, one can chip away at the project and overtime develop our database into something extremely useful.

Using Your New CRDM Interactive System

Your system is now in place and you finally have gathered information. As soon as there is data in your system you can begin to generate reports and you can take some action. If all the information is in place - that is wonderful. If there is very little information in place that too is still useful. In reality, the system is designed to never be complete. It is always changing because our campuses are always changing and technology and methods of education are always changing.

So the completion of a system is not critical. You can begin to use the system to support budget requests. If the only thing on your system is your projects in the public interface areas, you can still extract that report, prioritize it and at least show the need in that particular area. That of course is going to raise the question of what about the flooring in the other areas. How are we going to know that there is not a greater need there? Or what about roofs, windows, plumbing, lights, what about the rest of the facility?

At that point in time you now have an opening to tell people about the CRDM system and tell people of your method of getting the information. If they claim that they need more information, be prepared to tell them what options are available, the costs of using professionals, and the time frame in which information can be obtained. Other options of using in-house people can be outlined, but be very careful to explain the impact this will have on daily operations and other activities that they are currently involved with.

As we get into the issue of Capital Renewal and Deferred Maintenance, the system is now in place for us to do something about these concerns. There is an enormous amount of data available for presentation purposes and we must keep in mind how to present things with the data available. While on one hand we must be careful not to swamp people with detail we also must be careful not to give just a few large numbers. People have to get a true feeling for what we are talking about.

Presentations, whether they are oral presentations with overheads, or slides, or whether it is a written document, should start out by giving an abstract or overview of the problem. Then the story of the large financial and operating exposure that the institution is facing is told. Later in the presentation we should show the level of detail that is in the system. If it is a written report, perhaps it is best to label it as an appendix so people don't feel compelled to read it line by line or are scared off by the thickness of the presentation. But yet it is there so they can look at it and see individual projects and understand the thoroughness and professionalism with which you have approached the subject.

In an oral presentation, the method of doing this might be to take a page or two to show them as an example. It might be very handy to show them some of the same data, but sort them differently; so they understand the capabilities of the system which would again would reflect upon the professionalism in which the issue was approached.

In any case, you now have something concrete to work with - you have facts. You have a lot of data and now it boils down to your individual creativity, your individual sense of perhaps the politics that are happening within your institution and the vision to see the opportunities that might arise to grab this data and transform it into useful winning information. You will begin to control the Deferred Maintenance on your campus and will begin to renew your campus facilities to keep pace with our ever changing world.

Humble

Pawsey

The Decaying Australasian Campus: The Antipodean Time Bomb

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Introduction

OK so we did jump onto the Decaying American Campus bandwagon. But the sad reality is that it is all too true in the antipodes and dare I say it, in Britain based on recent observations. One can then perhaps admire the optimism of the New Zealand government when they say in the policy document Learning for Life August 1987: "An institution cannot progressively run down its value by repeated sale of its assets (or through deferring maintenance, or under-insurance and the subsequent loss of a building, and so on) because there will be a net worth target set for each institution."

Mind you, whilst we are all very interested in these matters, they tend to be overshadowed a bit by the tumult and the turmoil of the Unified National System (UNS) of Higher Education in Australia. Some background information about the UNS is essential to an understanding of why Directors, Buildings and Grounds (and all the other titles used for that job) are waging war on a wider front than the decaying campus.

The joint authors are respectively Director, Buildings and Grounds at The University of Queensland and Deputy Vice-Principal (Property) at The University of Melbourne and immodestly claim that in their 20 years plus in the educational facilities business, each has gained some insight into just what this problem really is about.

PART 1

A Unified National System ("More with Less")

Sometimes ironically referred to as Uniform National System of higher education, the UNS can be largely attributed to the efforts of one person, the Hon. J.S. Dawkins M.P., Minister for Employment, Education and Training. It's all fairly clearly set out in Higher Education - A Policy Statement, July 1988[1]. However, it is doubtful if any of us at that time quite foresaw the extent of the impact that these radical proposals were to have. Despite constitutional confusion in Australia as to state and commonwealth government responsibilities for education, the Commonwealth reign supreme in higher education because they almost totally fund it using tax revenue as a basis for grants back to the states. Until very recently, tuition was free across the board and even now represents less than 20 per cent of average cost per head. The Higher Education Contribution System (HECS) levies $1800 per student per annum after income reaches a certain level. It can be discounted by payments in advance. Overseas students now pay full fees but many are on scholarships. Our initial flirtation with private universities (Bond etc.) seems to have been singularly unsuccessful, which many regard as a tragedy.

This paper is being written immediately following the federal election of March 1990 which returned to power the Labor government for a record fourth term. Before anybody gets very excited about this, remember that Australians are election freaks with no fixed terms for governments, state or federal. However, Labor are in again, ostensibly for three more years and Mr. Dawkins is back at the head of the DEET portfolio. It seems to suggest more of the same. What follows is a brief analysis of the UNS, extracted from various published reports and newspapers:

"Commonwealth support for growth and reform in higher education will focus on those institutions which make up the unified national system of higher education. This system will consist of a range of higher education institutions with specific missions agreed with, and funded by, the Commonwealth."[1]

A tidal wave of change has swept over Australia's higher education system. Every institution, every academic, every student has been affected. In the late 1980s and the early 1990s the entire tertiary training landscape is being transformed.

With the dawn of the new decade, almost all of the country's colleges of advanced education will have disappeared. More than 200,000 students who enrolled for a college degree in the past two years will graduate in the 1990s from a university. The colleges will have been legislated out of existence. In place of the twin-peaked complex of universities and CAEs there will be a smaller, flattened block of jumbo-sized (in relative terms), multi-sited universities.

In Victoria alone, most of the technically minded, vocationally oriented colleges will have gone. Probably 14 out of the 16 CAEs that were present when 1989 began will have merged with one or more of the others, or with one of the four universities, to create a university-dominated higher education system with perhaps only seven institutions. A year ago there were 22.

Melbourne University could add another 7000 students to its enrolments as a result of the amalgamations. The university is being joined by the Ballarat College of Advanced Education, the Victorian College of Pharmacy, the Hawthorn Institute of Education and the Victorian College of the Arts. One new university will have been formed. Melbourne's western suburbs will get their first university when the Victoria University of Technology begins operating.

Across Australia the story is the same: mergers will cut the number of higher education institutions from 70 to 34. More important to both staff and students, the long-held, clearly delineated distinction between the universities - which carried out research and got more government money for doing so - and the basically teaching-only colleges, will be wiped away.

Despite the consolidation of institutions, the whole system is undergoing an extraordinary expansion with more money and more students than ever before. The number of undergraduates and those taking further degrees has shown an explosive increase, rising by 50,000 in the past three years.

This will put extra pressures on institutions whose administrators already feel overburdened by new Commonwealth demands. For the first time, they have had to justify the federal grants they get by providing "education profiles", statements that identify the role and mission of the institution, including such things as fields of study, areas of research and the enrolment mix of their students.

University and college heads have had to review almost every facet of their operations, including their admittance policies, the length, mix and content of the courses they offer, the terms and conditions under which academics are appointed, and the drop-out rates of their students.

Academics meantime are experiencing their own traumas and not only from having to cope with what some have called "Canberra's merger mania". In a trade-off for a six per cent pay rise, academics have had to accept major changes to their traditional terms of employment, including salary loading for sought-after scholars and new dismissal and disciplinary measures for unsatisfactory performance. It might be argued that this is no bad thing, but it represents radical change and resistance is predictably strong.

The agent, the driving force behind the greatest upheaval ever experienced in Australian higher education history, is the Minister for Employment, Education and Training, Mr Dawkins. Aggressive and ambitious, imperturbable and apparently impervious to the insults of academics, the protests of students, or public pressure from vice-chancellors, Mr Dawkins has shaken the tertiary education sector to its foundations.

In a mere two and a half years in the job, Mr Dawkins has created a "unified national system" of higher education, scrapped the former tertiary education and school commissions, forced universities to reform their management practices and enrolment policies, made the allocation of research money more competitive, cut the number of institutions offering external study courses from 48 to 8, increased enrolments by more than 30 per cent - and introduced the world's first tertiary tax scheme that obliges students to pay a significant portion of the cost of their tuition as a tax levy when they get a job.

Criticisms from the academic community over many of these changes have been harsh and unrelenting. Professor Peter Karmel, a former chairman of the Tertiary Education Commission and vice-chancellor of the Australian National University until 1987, has attacked what he calls "the cult of the big."[4]

Professor Karmel points out that in the United States the most distinguished universities are not among the largest. Some of the best under-graduate education in America, he says, is to be found in colleges that in Australia would not qualify for membership of the unified national system, or would be encouraged to merge. (2000 and 8000 students are key numbers.)

Like Peter Karmel, University of New England professor Grant Harman warns that the disappearance of the advanced education sector could lead to the loss of some of the CAEs best features. The new mega-universities, Professor Harman says, are likely to drop the lower level work offered in the colleges, tighten admission standards and make courses much more theoretical and far less directly vocational and applied.

College academics, too, traditionally have shown much greater concern than their university counterparts about the quality of teaching and about innovation in teaching techniques. "New courses in CAEs generally were much more thoroughly thought through and key people outside higher education had meaningful input into course design."

The Vice-Chancellor of Melbourne University, Professor David Penington, has been one of the country's most outspoken critics of the Dawkins reforms. He describes the new unified national system as a "uniform national system" and talks of a "levelling out of higher education."

"Damage to academic morale which has followed the Dawkins reforms has had a profoundly negative impact," Professor Penington says. "The reforms were seen as an onslaught on all that mattered to many members of the academic community."

Professor Penington condemns the abolition of the Tertiary Education Commission and the greater say the Commonwealth now has over the allocation of grants to universities. "Ministerial control in resource allocation inevitably leads to the granting of political favours, such as is emerging progressively in the funding of new initiatives, funding linked with desired amalgamations or threats to withhold funds from institutions that fail to comply with the minister's wishes. Section 96 of the Australian Constitution, which provides for conditional grants by the Commonwealth, is being used as a powerful, even brutal weapon both by the minister and by bureaucrats!"

Harsh words and Mr Dawkins rejects them with equal vehemence. "I haven't forced a single amalgamation. The only thing we have said is that if an institution enrolled less than 2000 students it could not be part of the unified national system. The mergers would not have happened had the institutions not agreed to them."

Mr Dawkins flatly disputes claims that the Federal Government is intruding more in university affairs. Universities were much more highly controlled when the Tertiary Education Commission existed, he says. "The commission ran around the country, for example, trying to stop institutions setting up law schools; they even tried to close one down. I'm saying that if an institution wants to rearrange its budget to set up a law school it can. So now there's likely to be half a dozen new law schools starting up over the next few years that would never have begun under the commission."

The Commonwealth did require more information from institutions in setting up the unified national system, Mr Dawkins says. But this was needed to improve the data base. One of the reasons the education profiles took a long time was that previously some institutions did not know what they were doing. "All we wanted, from the point of view of accountability, was for them to tell us what courses they were running, how many students they had, and so on. We weren't telling them what to do. Yet the fact is that some did not have research management plans, some did not even know what courses they were running. The ones that already knew and were well managed and had plans, then their workload was not great."

To settle the issue once and for all, Mr Dawkins has proposed a charter of autonomy and academic freedom. Although the idea has been greeted with scepticism in the cloisters, Mr Dawkins says he wants the charter included in future funding legislation to ensure that Commonwealth requirements of institutions can be kept properly within strict limits.

Mr Dawkins admits to becoming impatient with claims by vice-chancellors such as Professor Penington that university incomes and the money spent on research has declined. In 1987, he says, just under $2.7 billion was allocated by the Commonwealth to higher education institutions. Another $78 million came from programs now administered by the Australian Research Council.

In 1992, that $2.7 billion will have grown to $3.3 billion, an increase of almost 25 per cent or $664 million in real terms. In the same year, grants to support university researchers and research students will have leapt to $208 million, a real rise of 250 per cent.

More student places will be created in return for these increased levels of funding, with overall enrolments rising by 21 per cent. Yet operating grants alone will increase by 20 per cent. "Since 1988 we have been funding new student places at their full cost and so over the next few years, the total amount of dollars per student will go up and not down. If the critics look to the future and not the past they can, for the first time ever, know what their budgets will be three years down the track. And if they do the calculations on dollars per student, they will see the money they get goes up."

Mr Dawkins says the major reforms he set out to achieve were intended to make higher education more responsive to national needs and to increase Australia's capacity to survive in an increasingly technologically competitive world. The reforms that are now in place he believes have wide support. He claims that even the higher education charges (HECS) under which students will be obliged to pay up to 20 per cent of the cost of their courses, has majority backing among students and the community.

Fears that the charge would lead to a fall-off in demand for higher education have proved groundless. Enrolments in all categories are up: the numbers of women, part-time and external students have all risen "despite the forebodings of those who said the charge would be a disincentive to participation."[2]

The Years Ahead.

The Commonwealth's strategy for Australia's higher education system represents the most determined move for change ever in the history of higher education in Australia. For good or ill, higher education will never be the same again. Behind the reforms lies a conviction that the higher education institutions have only a limited capacity to promote change internally and to adjust to changing external forces, and that change will have to be imposed on them. Although determined leadership in some institutions has shown that some internal reforms are possible, it must be conceded that the institutions do not display much capacity to change themselves. The strong flavour of collegiality that remains in the institutions, with much decision making in the hands of large committees, ensures that many academics believe that they should have an ultimate veto on managerial decisions. Moreover, academic institutions tend to be composed of many relatively small, disparate units, each with its separate expertise; these tend to be highly territorial, erecting barriers around themselves and behaving feudally.

While there may be considerable doubt about the directions which some of the structural reforms are taking, many of us will concede that internal reforms are necessary. There needs to be a more managerial approach to the work of institutions, a greater emphasis on performance and a more competitive allocation of resources. Nevertheless, the mission of institutions of higher education has not changed. The raison d'etre of the university lies in the conservation, transmission and extension of knowledge and in the application of knowledge. The external forces to which the institutions are subject are the policies of governments and the demands from the community. If these forces make such demands on institutions that they are diverted from their internal mission, or if the special environment of free inquiry needed for the pursuit of knowledge is impaired, the institutions will no longer flourish and the quality of their academic staff, their graduates, their research and their contribution to the community will decline.

The reforms of the late 1980s are not about to be reversed, although doubtless some mergers will fall apart or not take place and some modifications of policy may be possible. Major structural changes have already taken place in the system of higher education in Australia and its relationships with the Commonwealth Government. We have to accept these changes, but we should build on them. We must capitalise on those positive elements that have flowed from the reforms - growth, emphasis on better management and performance-based evaluation, competitive research funding, appropriate consolidation. But we need to proclaim loud and clear that the institutions have served Australia well over a long period. We need to insist that the special characteristics of institutions of higher education must be recognised and that they are neither business nor bureaucracy. We must assert that they are engaged in the pursuit of truth in the widest sense and that their ethos cannot be one of a narrow instrumentalism. We must avoid artificial and contrived structural changes. Finally, and perhaps above all, we must resist unwarranted political and bureaucratic intervention and argue for a return to the days when the institutions were at arms length from the Government.[4]

PART 2

The Decaying Australian Campus - A Case Study

It is simply not necessary to undertake a study of the nature or size of The Decaying American Campus - A Ticking Time Bomb 1989 to know that the essential findings also apply in Australasia. That can be said in confidence because it was all done on a national scale in 1985 The AVCC Universities Building Survey Working Party 1985 "The Ritchie Report". That group, of which both the authors were part, clearly established a substantial level of under funding of both maintenance and rehabilitation in all Australian universities. Worse, it also identified significant levels of indifference to these matters although much of this has altered over time.

Most, but regrettably not all institutions in Australia have taken a more professional approach to facilities management as a result of the 1985 determinations and of course the efforts of APPA to which most now belong. Both the authors have for some years been working with Dr F. Bromilow (formerly of CSIRO) on Life Cycle Costing models for institutional buildings.[5] A useful predictive model for Life Cycle Costs has been established from this work.

The following is part of a late 1989 report on the physical facilities at the University of Queensland and is indicative of the national problem:

Definitions.

The following terms used in this report are as defined in reference A viz:

(a) Life Cycle Costs (LCC). The total cost of an item throughout its life including planning, design, acquisition, support and disposal costs.

(b) Maintenance. All actions necessary for retaining an item in *or restoring it to a specified condition** but excluding building cleaning and rehabilitation.

(c) Deferred Maintenance (DM). Maintenance which is known to be required but which has been *deferred deliberately to a later date** for example, because of a shortage of funds or unavailability of parts.

(d) Preventive Maintenance (PM). The actions performed to retain an item in a specified condition by *providing systematic inspection, detection and prevention of incipient failure**. Preventive maintenance is normally programmed.

(e) Corrective Maintenance (CM). The actions performed, as a result of failure, *to restore an item to a specified condition**. Corrective maintenance may or may not be programmed.

(f) Rehabilitation. Extensive work intended to bring a building or property *up to a new standard or to alter it for a new use**. Rehabilitation involves maintenance activities and improvements.

(g) Rehabilitation Statutory. Rehabilitation that must be carried out to meet statutory requirements.

* Italics added for emphasis.

A Theoretical Foundation.

Universities and similar institutions if not unique as builders are certainly esoteric. They are not developers, and their properties in the main are not seen in commercial terms, although many aspects of institutional building life-cycle and associated costs are properly measurable and manageable in such terms. Whereas commercial buildings are built for a specific life between 40-70 years (with many not going that distance), Universities quite literally build forever. The paradox is that the system of formula funding and space demands imposed are such that Universities are forced to build cheaply, with compromises often being made in selected kinetic systems (lifts, air conditioning, etc) with serious long term cost consequences. Clearly many University buildings are at the end of an "economic life" and should be demolished to make way for better, usually bigger more technically efficient with better land use buildings. It is difficult to imagine the capital funding climate ever improving to allow for such obvious rationalisations.

All this opens up the concept of Life Cycle Costs, a term which simply recognizes that the least cost in the whole life of a building is its initial construction cost. Moreover, when calculated and applied the concept shows a very clear nexus between the quality of a building as built and its total operating and maintenance costs. Cheap buildings cost more money to operate and maintain and that is true up to a point beyond which it does not pay to continue to improve initial quality. The total cost per unit area of both acquiring and maintaining a facility over building life T is, by definition, the sum of the capital cost (CI) and the accumulated sum of maintenance costs (M), cleaning costs (c), energy costs (H) and other costs (K), less any disposal value (D) at the end, in present value terms. Let ST = total life cost per unit over life T; then -

$$ST = CI + MT + cT + HT + RT + KT - DT$$

where CI = initial capital cost
MT = accumulated present values of maintenance costs over period T,
HT = accumulated present values of energy costs over period T,
cT = accumulated present values of cleaning costs over period T,
KT = accumulated present value of other recurrent costs over period T,
RT = accumulated present values of rehabilitation costs over period T,
and DT = present value of disposal value (D) at time $t = T$. (for a university = 0)

This equation defines the total life-cycle cost per unit area of a facility in present values at time $t = 0$. As an example over a life cycle of 100 years a typical $5 million building will consume $8 million in electricity costs, cost $7 million to clean and about $12 million to maintain and rehabilitate.

It will be obvious that building costs, particularly MT and RT above are not linear. There is a "honeymoon" period with most new buildings which can last up to ten years with reasonable but not unduly expensive preventive maintenance measures. Beyond that, costs increase rapidly reaching significant maintenance and/or rehabilitation peaks typically every ten years, that is 10, 20, 30, 40 years, etc. as various systems wear out or become obsolete. There is also a nexus between the Preventive/Corrective Maintenance trade-off and widely different views as to where in that maintenance management spectrum a rational, affordable and appropriate maintenance plan for each building should lie. This University believes that preventive programmes in the order of 15% of total maintenance funding provides an effective balance between reliability and costs. (See the later section which discusses the long-term reduction in preventive maintenance).

The existing rigid separation of Capital and Recurrent funding fails completely to recognize the unarguable nexus between these funding categories in respect of long term physical assets, such as buildings. This has caused an obvious failure to recognize the life cycle cost implications of all capital development. It has resulted in the worst of all possible developmental strategies; the building of new buildings to maximize space at the expense of the much larger downstream operating and maintenance costs over the whole life of the building. In particular the kinetic systems (mechanical and electrical) are compromised in the quest to gain maximum floor space for the formula grant provided, which usually also carries a minimum space caveat.

An International Problem

The problems in Australian Universities have also been addressed in both the UK and the USA. Many have walked this path including the UK Committee of Vice Chancellors and Principals, the Universities Grants Commission and international organizations such as the Building Owners' and Managers' Association (BOMA) and the Association of Physical Plant Administrators of Colleges and Universities (APPA). Publications such as those by Harvey Kaiser of Syracuse University Mortgaging the Future: The Cost of Deferring Maintenance 1979 and Crumbling Academe - Solving the Capital Renewal and Replacement Dilemma 1984, both US publications, freely addressed this whole question of inadequate recurrent funding of physical assets. It remains a major concern in the USA as clearly indicated by The Decaying American Campus - A Ticking Time Bomb, 1989.

Australian Solutions

The National Committee on Rationalised Building (NCRB) first addressed this problem some twelve years ago when it formed a Maintenance Management Sub-Committee (now called Facilities Management Sub-Committee). The Sub-Committee's charter goes to addressing such things as terminology, asset registration systems, life cycle cost performance, data recording, energy management, use of computers in facilities management and other matters relevant to standardizing recording and other systems. In addition to this, BOMA is very active in Australia and has an active regular standard information exchange between all major commercial property owners. (Mr W.J. Humble is a founding member of the Facilities Management Sub-Committee and an ex-State President of BOMA and Mr M. Pawsey is also a long time member of the Facilities Management Sub-Committee.)

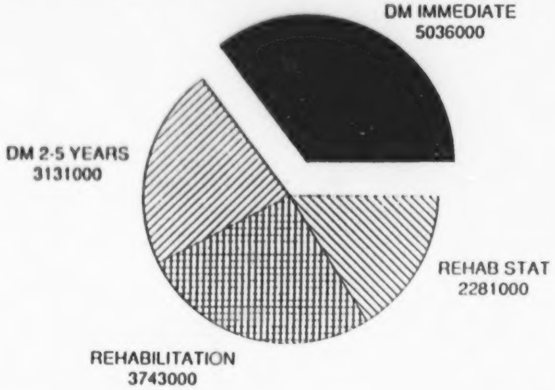
Formula Funding

A good deal of work has also been done, particularly by APPA in USA, towards developing acceptable formulae or norms for planning Maintenance and Rehabilitation expenditures, appropriately termed Capital Renewal and Replacement (CRR) in USA. Whilst these are at best empirical, experience in Australia suggests close correlation provided they are honestly applied over time. They are at the best indicative average annual costs and presume sinking fund or similar systems of accrual accounting. Publications such as Formula Budgetting - An Approach to Facilities Funding 1980 (an APPA Publication) are typical.

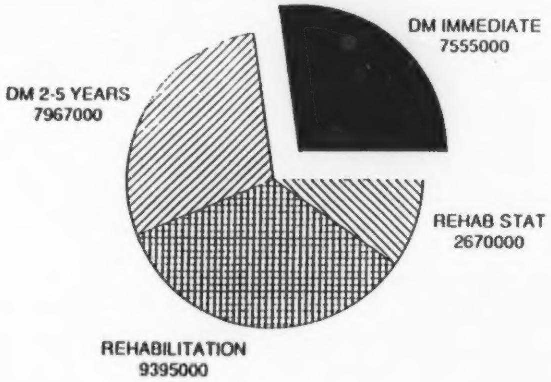
Figures vary, but Stanford University as a typical example, budgets for 1.5% of Current Replacement Value per annum (CRV). Certainly 1.25% of CRV is a necessary minimum if accelerated deterioration is to be avoided. It needs to be stressed that these norms apply over the whole life of the building, i.e. 1.2 per cent of CRV (on average) every year from the date of practical completion.

Current Status of University Building Stock

In its first detailed building audit report to Senate (The Governing Body) in October 1988, the Buildings and Grounds Division recorded the following unfunded liabilities:



The 1988 report excluded University buildings not at St Lucia (i.e. Medical School, Pinjarra Hills, etc). In addition to the inclusion in 1989 of all University properties, the inspection program has been carried out in much greater detail using computer aided techniques. As a result, the following new levels of liabilities have been recorded for 1989:



This represents a significant jump of 94 per cent in the categories taken together and can be largely attributed to the reasons given above.

Most accurate are the figures for the Deferred Maintenance categories which now include a very high percentage of existing defects. The recording of Rehabilitation, such as the upgrading of lecture theatres, laboratories, passenger lifts and underground services (e.g. upgrading chilled water lines, electrical supplies) has increased liabilities under that heading by more than 150 per cent. However, the Rehabilitation category still remains somewhat uncertain, since no provision has been made for major rehabilitation works of the scale of the Law Library, or for technological rehabilitation (The issue of technological rehabilitation may be best addressed by an academically supported task force or working party). The most debatable of all figures is that of Statutory Rehabilitation. The real impact of such demanding new legislation as the Workplace Health and Safety Act (1989) and Regulations has yet to be addressed in any detail. The apparently retrospective provisions in this legislation have been excluded from the report as have asbestos removal programs, the full extent of which are difficult to quantify. The more demanding legislation of the other states in this area will eventually catch up with Queensland and the University's liability under this Statutory Rehabilitation heading is likely to escalate sharply as a result. No assistance from the Commonwealth or State is likely to offset these statutory expenditures.

In summary then, the concerning figures provided above remain conservative estimates and almost certainly represent only part of the real problem of under-maintaining and running down of capital assets.

The Data - What Does It Really Mean?

In order that the condition of individual buildings can be more effectively portrayed, data has been presented in two forms;

1. Actual dollar costs by category by building, e.g. $400,000 - Deferred Maintenance Immediate - J.D. Story. This highlights where the major dollar deficiencies lie. Appendices 1A to 1D summarize this data for buildings greater than 2000m2. Actual detailed costs are given in Appendix 3.

2. Each category as percentage of Current Replacement Value (CRV) e.g. Deferred Maintenance in J.D. Story amounts to 6.8 per cent of its CRV. Clearly, the higher the percentage, the worse is the condition of the building (see Appendices 2A to 2D).

For the macro-picture, reference is directed to Appendices 4A and 4B which are summaries by building of all categories contained. Appendix 4A highlights the problems within the older University buildings (the Great Court 1936) and in buildings containing the science and biological sciences disciplines. Seventeen (17) buildings require more than $500,000 to bring them up to acceptable (i.e. original) condition with seven of these exceeding $1 million in maintenance and rehabilitation requirements.

Appendix 4B is a better measure of condition. It can be seen that on average approximately ten percent of CRV for each building is required to bring the building stock back to an acceptable condition. A dozen buildings require in excess of 10% of their CRV to restore or rehabilitate them to an acceptable standard.

The Increasing Trend Towards Corrective Maintenance

In the ideal facilities management condition, flexible and adequate funding allows the facilities manager to employ only preventive and corrective maintenance; no maintenance backlog exists. An optimum balance between these two forms of maintenance, measured in terms of reliability and cost, ensures effective and efficient use of maintenance funds. However, in the real facilities world, managers are all forced to defer maintenance work where inadequate funding prevails. Such is the case in all but a handful of universities. Appendix 5 highlights the problem and shows how diminishing maintenance funding is eating away at the preventive (PM) and deferred (DM) maintenance cake. At current funding levels, the Buildings and Grounds Maintenance Section is accelerating towards a corrective maintenance only mode of operation. Appendix 5 also highlights the sharp rise in DM, concurrent with the swing to the corrective maintenance mode.

Maintenance Funding

There are a number of reasons why it is becoming very difficult to stretch the maintenance dollar further: (1) There has been a real decline in Buildings and Grounds funding; (2) The University's building stock is both increasing and ageing; (see Appendix 6) (3) The total population is increasing with consequent increase in usage patterns of buildings.

Appendix 7 shows the decline in maintenance/cleaning costs during the period 1980-89 (28 per cent). Only through significant cost saving initiatives by the Division in the area of cleaning management has it been possible to maintain maintenance funding at current levels. The situation would have been much worse had such initiatives not been implemented. Despite this "cross-subsidization" between operating sections, however, it has been conservatively estimated that maintenance works continue to be underfunded in the order of $1 million/annum. Such estimates are supported by the ever increasing size of the deferred maintenance register which in the 1989 building and services audit has topped $7.5 million. The work of Dr Bromilow et al also confirms the inadequate levels of maintenance funding at Melbourne and Queensland Universities and the likely long-term effects of "mortgaging the future". Predictive models established by this empirical work are now being used for forecasting of maintenance funding.

The Problems Get Worse

The University of Queensland is relatively young in building terms, with an average building age of twenty-four years. Despite the limited research done on the ageing of buildings it is clear that they cost increasingly more to maintain over time. Indeed, some older buildings and services have been known to fail completely, sometimes catastrophically, resulting in costly rehabilitation replacements. New technologies and equipment sometimes fail "to fit" old buildings. If we have a problem with ageing buildings now, it would be safe to assume that the situation will worsen with time.

In 1987/88, the Buildings and Grounds Division worked with Dr F. Bromilow, former CSIRO Project Leader of Life Cycle Performance Research. Dr Bromilow has carried out detailed studies of three major buildings at the University of Melbourne and our Chemistry building at the St Lucia campus. Results suggest that we are spending, in the Chemistry building, approximately 0.7 per cent of its CRV per annum on essential maintenance work. Dr Bromilow's initial funding model recommends that maintenance funding in the "honeymoon years" 1971-1991, should be at a rate of 1.05 per cent of CRV ($2.425 million). This figure inflates to 1.65 per cent for the balance of the building's planned 100 year life cycle as rehabilitation needs and statutory obligations increasingly take their toll.

In 1990, the Buildings and Grounds Division will allocate much less than 1 per cent of CRV to maintenance ($3.5 million to maintain $450 million of building assets = 0.8% CRV). World wide research, particularly from the UK and USA, and now confirmed in Australia, supports minimum average levels of maintenance funding at 1.25 per cent CRV. The message is clear; pay now or pay more later.

Summary

The 1989 facilities audit has identified $27.8 million in unfunded Maintenance and Rehabilitation. That figure now represents 6.1 percent of The University of Queensland's estimated current replacement value. The scale of this problem is typical of many larger Australian Universities. It seems only a matter of time before mechanical services (e.g. fume cupboard systems) will, of necessity, be deemed unsafe and shut down on health grounds alone. In the building trades area the already inadequate painting program will be further reduced with obvious deterioration to the internal condition of the building fabric.

The University's underground services (conservatively valued at $100 million), which have provided a relatively trouble-free service in the past, will fail in the future. Only an adequate sinking fund provision can effectively prepare the University for these certain failures.

New legislation and technological changes are likely to be major factors in the operation and maintenance of buildings in the future. Health and safety demands will certainly increase, reducing further the funds available for essential maintenance works.

The UNS increases in the student and staff populations will impinge directly on facilities management, as buildings and services are worked harder. With the exception of the roof, virtually every element in a building will be expected to operate longer, work harder and provide reliable service. Only increased maintenance funding will allow such demands to be met.

Conclusion

The problems detailed above are not peculiar to The University of Queensland. Indeed in comparative terms the position is better than average for Australia. This is not accidental but has been achieved from careful life cycle cost strategies and effective and efficient management of budgets including cost savings in such division areas as cleaning and overheads. However, as the growth in building stock continues (Appendix 6), the remaining buildings age, resulting in ever increasing maintenance and rehabilitation costs. Mortgaging the Future is not an alternative strategy.

PART 3

Are there Solutions to the Facilities Management Problems?

Solutions to the problems outlined basically relate to the major funding difficulties, present in all of our systems, which have caused them. This is an Irish way of saying that ample money would overcome most of these difficulties. However, that Facilities Manager's Paradise is about as likely as the Cargo Cult in New Guinea (a quaint view about the gods delivering unlimited goods from the heavens which dates from parachute drops during World War 2.) We must look elsewhere than the heavens, although better funding methods must be an objective. The solutions advanced are a series of proposals, any one or any combination of which should be considered in addressing the Capital Renewal and Deferred Maintenance problems.

Better Management

Obviously, if there are not enough dollars to fund the required programs, then ways must be found to make more effective use of the available dollars. Hardly a profound thought; but a solution often ignored.

APPA programs and publications provide information and suggestions, as an example the recent publication Financial planning guidelines for Facility Renewal and Adaption. That particular document is one of the best appraisals of the whole problem and offers good examples of how institutions have approached the problem.

We would like to review again what we are trying to do in this direction in Australasia. There are a number of agencies working together on these problems:

Australasian APPA Section - now comprising 47 Australian and New Zealand institutions of Higher Education;

Australian Vice-Chancellor's Committee (AVCC) Conference on Facilities Management. This conference comprises the facilities management staff of the Universities and therefore has a common membership with the APPA Section.

AVCC Working Group on Buildings. A selected group from the above, working to the Vice-Chancellor's Committee on specific issues (Maintenance Management, Space Allocation and Control, Performance Indicators, Capital Programming.) (Both authors are members.)

National Committee for Rationalized Building (NCRB) Facilities Management Sub-Committee. A group from our Federal and State Construction/Housing/Health authorities, Universities (common membership with the above), BOMA (see below) and Commerce and Industry. Working on similar issues but with a more diverse membership. (Both authors are members).

Building Owners' and Managers' Association (BOMA) An organization originating in the United States, with membership principally from developers, large construction firms, large property owners such as the Insurance Companies. Has many similar interests to all of the above but primarily in commercial Office buildings and Retail Shopping Centres. (Both authors are members through their institutions.)

Projects in Progress.

The above groups are working on a diverse array of projects in Facilities Management, usually directed towards better Maintenance/Rehabilitation management. Many of these projects are being run in close cooperation with one or more of the above agencies, with a view to producing a common result and reducing overlap of activity. The major projects under way in these groups which would lead to better (more efficient, less costly) management of facilities are:

Common Terminology

As we have said before, if you cannot describe an item, how can you understand or exchange information on that item? So common terminology definitions have been prepared and are being extended throughout Australia. Some examples are in Part 2 of this paper.

Chart of Accounts

A common approach to recording expenditure is necessary, particularly as Life Cycle Costing (LCC) techniques are being applied. Data bases of costing information are being exchanged by all of the above agencies and a National Data Base of Facilities Management costing information is under consideration. A common approach or a common Chart of Accounts is essential.

The NCRB has prepared such a Chart including the recommended elements of a building on which detailed costs should be retained. This Chart has been adopted by the Universities. BOMA has also a Chart of Accounts, with a bias to operating costs of Commercial and Industrial buildings. A project to achieve a common NCRB/BOMA Chart is in train.

Maintenance Policy (Philosophy)

Universities have been encouraged to develop a formal Maintenance Policy, in which the institution's philosophy on maintenance (including standards and approach to preventive maintenance) is clearly expressed both for the facilities management staff, the academic community and the University administration.

Facilities Management Systems.

Effective control means a move to the greater use of technology, particularly computer systems. Extensive use of the following systems is now common.

. Maintenance and Project Cost Control and Programming Systems providing better control, but also a better data base, particularly for Life Cycle Costing.

. Central Control and Management System for Electrical load and Energy Management, Mechanical Services operation and control and Security (including Parking control).

. Space Management Inventories and Systems.

. Bar-coding/computer systems to simplify Facilities audits.

. Diagnostic systems (including heat sensing devices) to detect problems.

Funding Solutions.

Although in our introduction we have suggested that the solution to the Capital Renewal and Deferred Maintenance problem is not going to lie solely in funding recoveries, nevertheless, this is an area where some element of solution must be sought. There are a number of ways in which this might be achieved.

1. Funding of Maintenance/Rehabilitation (Capital Renewal)/Deferred Maintenance.

Pressure must always be maintained to increase the level of funding of routine maintenance as well as capital renewal and deferred maintenance. There are many and varied references suggesting minimal levels of funding on these matters, and we will refer below to a few of these: Sherman and Dergis 1981 A Funding Model for Building Renewal. Hudson and Biedenweg 1982 Before the Roof Caves In - a Predictive Model for Physical Plant Renewal. Dunn 1987/88 Plant Upkeep and Financial Equilibrium - What Does it Take to Stay in Balance. Kaiser 1980 Facilities Management - A Program for the 1980s. Kaiser 1984 - Crumbling Academe.

Recommended Level of Funding of Maintenance. There is some difficulty here in relating Australian experience to that of the United States. It is clear that in most cases, your funding authorities and experts and your individual institutions, make a provision for routine maintenance (the repair of things which stop operating or breakdown) and preventive maintenance in operating expenses. In most cases, replacement of items which have failed completely or have reached the end of their economic life, which could include items of mechanical plant, floor or wall surfaces and roof surfaces, together with allowances for deferred maintenance are included in Capital Renewal and Deferred Maintenance (or the new term "Facility Renewal and Adaption"). In Australia, all the above elements of maintenance including deferred maintenance are usually treated under one heading using the definition referred to above i.e. "all actions necessary to maintain an item or restore an item to its original condition." Therefore, we will talk about maintenance under the above rules; that is, all elements of maintenance, routine and preventive and replacement under the heading of maintenance and referred to separately deferred maintenance.

After a long examination of the above references and others in both United Kingdom and United States, the Universities on the recommendation of the AVCC Buildings Working Group adopted (in principle) a recommendation that the desirable level of funding of maintenance was of the order of 1 per cent to 1.5 per cent of current replacement value of buildings and services.

In fact, in no case in the universities in Australia is that minimal level of funding being achieved. Where the range is appropriate, there are some universities spending over 1 per cent, but in every case those universities ought to be spending 1.5 per cent. The range, of course, is intended to provide for the wide variance between old and new universities, those with a full range of disciplines compared to three year colleges or universities or two colleges. The average expenditure in the universities in 1988 (the last year available) was, in fact, about .8 per cent of Current Replacement Value (CRV), well below the level of what might be the medium of the above range. The level of Deferred Maintenance was high. It was last measured substantially in 1985 at a total of $56,000,000 in nineteen universities. Given the above level of under funding, it is obviously increasing sharply. See Part 2 for indicative percentages. It is clear, therefore, that while an increase in funding might well be a solution, we are not achieving it yet in Australasia.

Rehabilitation (= Capital Renewal) Capital Renewal (Rehabilitation) is the life blood of the facilities of a dynamic university. Faculty requirements for change to accommodate new technology, new technique, new centres for research is one factor requiring constant change and upgrading of facilities. Another is the requirements of health and safety authorities, upgrading of ventilation, fume cupboards, escapes from buildings, fire service, detection and prevention systems, removal of Asbestos, PCBs - you know them all - we face them too. Funding is just as tight and financial controllers (the "bean counters") just as reluctant to provide funds for capital renewal as they are in the United States. Donors find no real attraction in putting their name on a rehabilitated laboratory. Our collective backlog of rehabilitation needs in 1985 was $126,000,000. Again, we do not have updated figures. As an aside, we should be saying that these figures probably sound very small compared to your $60,000,000,000 worth of capital renewal and deferred maintenance outstanding, but you have 3,000 institutions at all levels of higher education, including two year colleges. We could probably get to 200 total in all categories, so the problem is real enough in relative terms.

Desirable Level of Rehabilitation Funding. We have sought for a similar level of funding to the 1 to 1.5 per cent for maintenance and after examining all of your recommended levels somewhere between 3 per cent and 5 per cent for capital renewal and replacement. We have assumed that a similar range of about 1.5 per cent would be the desirable level for rehabilitation (capital renewal) alone.

2. Other Funding Options

Assuming that your institution(s) cannot significantly increase its level of funding support, then we have to look at other options which would include:

(a) Seeking External support, but as already discussed in this paper and in others, donors are not really interested in maintenance or rehabilitation. They like to see their names on new buildings.

(b) Waster of Assets - Use of Seeking Funds or Depreciation. The recent Northern American publication "Financial Guidelines for Facility Renewal and Adaption" has provided a great deal of consolidated information of this whole topic, particularly case studies on what some institutions have done.

The recent NACUBO/APPA seminar on capital renewal funding also covered this topic in great depth, particularly definitions and a formula for depreciation. Those definitions and expressions of view about the treatment or depreciation in institutional accounting, are noted and are now taken into consideration in what we are about to say here. It is particularly noted, for example, that the NACUBO guidelines suggest that depreciation is not a source of funds for maintenance. That view is noted and understood, but after all, financial controllers are not Facility Managers and do not face the same problems. We would like to suggest that some consideration needs to be given to a review of that opinion.

"Wastage" of Assets. We all know that the value of our assets (facilities - buildings) decreases each year. They are wasting away for a number of reasons. These reasons include maintenance deferred, buildings becoming a year older and therefore a year out of date; laboratories and specialized facilities also becoming out of date as technology and techniques change. How do we overcome this wastage of assets? Obviously, from the traditional sources which include: operating expenses; capital; and funding from internally and externally.

Additional Possible Sources - Sinking Funds and Depreciation Reserves. We would like to be a little heretical, and perhaps controversial and suggest that it is time that radical measures were considered. We suggest two related possibilities:

Sinking Funds. Many authorities have talked for a long time about the use of sinking funds. This involves the transfer of a previously determined amount each year usually escalated to match inflation into a fund known as a sinking fund. The intention is to even out the wide fluctuations in maintenance, particularly replacement maintenance. Work done at The University of Melbourne and The University of Queensland on Life Cycle Costing shows that in most of the buildings studied over a hundred years (refer Bromilow and Pawsey 1987) the investment of 19 per cent of the original building cost, in a sinking fund at the real interest rate of 6 per cent would fund maintenance over the whole life of the building - all maintenance. It is of interest to note that in the same exercise, it was established that 52 per cent of the original building cost invested on the same basis, would fund operating costs as well as maintenance for the life of the building. Again, in the same reference 1.1 per cent of the original building cost suitably inflated would meet the cost of maintenance over a hundred years.

Obviously, the problem with these proposals is the provision of the funds either at the beginning of a project or on an annual basis. Either would represent a very substantial increase in present funding for maintenance. However, it is a feasible solution. It would overcome the present cycle difficulties of maintenance.

Use of Depreciation Allowances. Although it is acknowledged that the NACUBO standard clearly establishes that depreciation is not a source of funds for capital or maintenance, an argument can well be mounted that it should be using the accrual accounting principle. The argument goes the value of the asset is wasting. Part of that wastage is unfunded maintenance as well as replacement maintenance. If the institution is writing down its assets, and if the institution treats that depreciation as a charge against its operating funds, then why not apply some of that fund to maintenance?

It is acknowledged that the weakness in the argument is that the same NACUBO standard suggests that depreciation should not be a charge against operating accounts, but merely an allowance against the Plant Fund account. However, we repeat the argument. If the institution does not make depreciation a charge against its operating accounts, why not increase maintenance funding progressively over a period to create a fund for maintenance?

3. Obligation of a Higher Education Institution to Preserve its Assets

One aspect which is not often, but should be an important point with higher education administrators, is an obligation to maintain and preserve its assets. Why should any particular generation of administrators or boards of regions create a problem for its successors. Surely it is morally wrong, if not legally wrong for a Board of Regents or a President of a university to neglect the preservation of those assets, deferring the problem to a future generation - Mortgaging the Future.

One country has at least recognized that obligation. In its recent review of higher education, the New Zealand Government published a document entitled Learning for Life 1987. In this document, setting a blue print for Higher Education in the future in New Zealand, the Government has placed an obligation on each University to maintain its assets and to report annually by seeking a certificate from each university Vice-Chancellor, that these assets have been adequately maintained. It is not yet obvious how those Vice-Chancellors will be able to report in that way as New Zealand universities suffer from the same blight of deferred maintenance as all other higher education institutions. Nevertheless, the New Zealand Government has recognized the problem whether it intends to fund the universities so that the problem can be overcome. It is yet to be seen.

Attachments

Appendices 1A-1D	Current liabilities by building in actual dollars
Appendices 2A-2D	Current liabilities by building in terms of per cent CRV
Appendix 3	Maintenance and Rehabilitation costs - Summary by building (over 2000 m^2)
Appendices 4A-4B	Total costs of Maintenance and Rehabilitation by building
Appendix 5	Proportions of Corrective, Preventive and Deferred Maintenance works 1982-1996
Appendix 6	Building Stock - St Lucia Campus
Appendix 7	Maintenance/Cleaning costs 1980-1989

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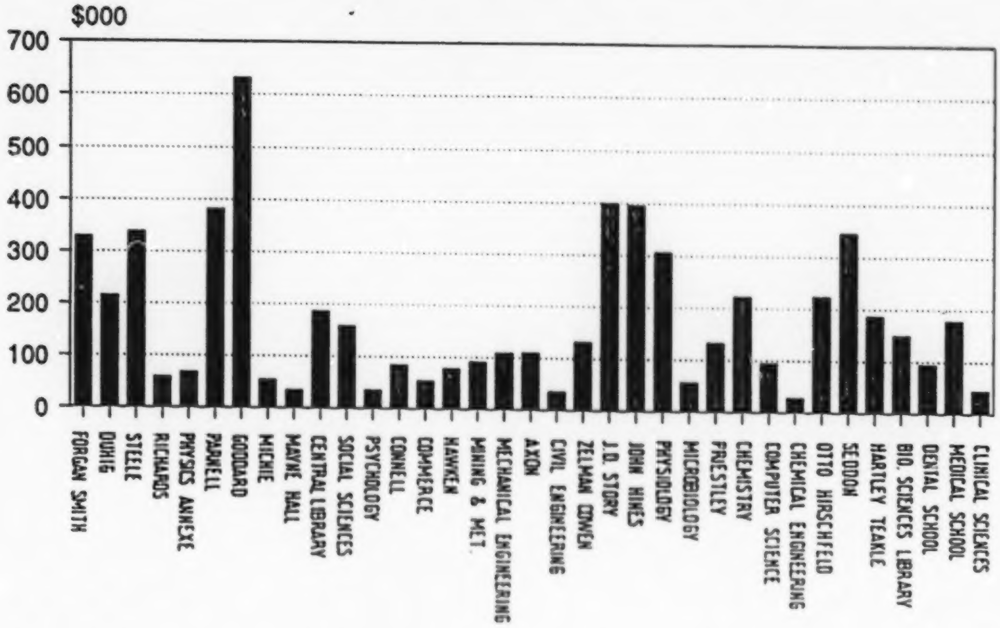
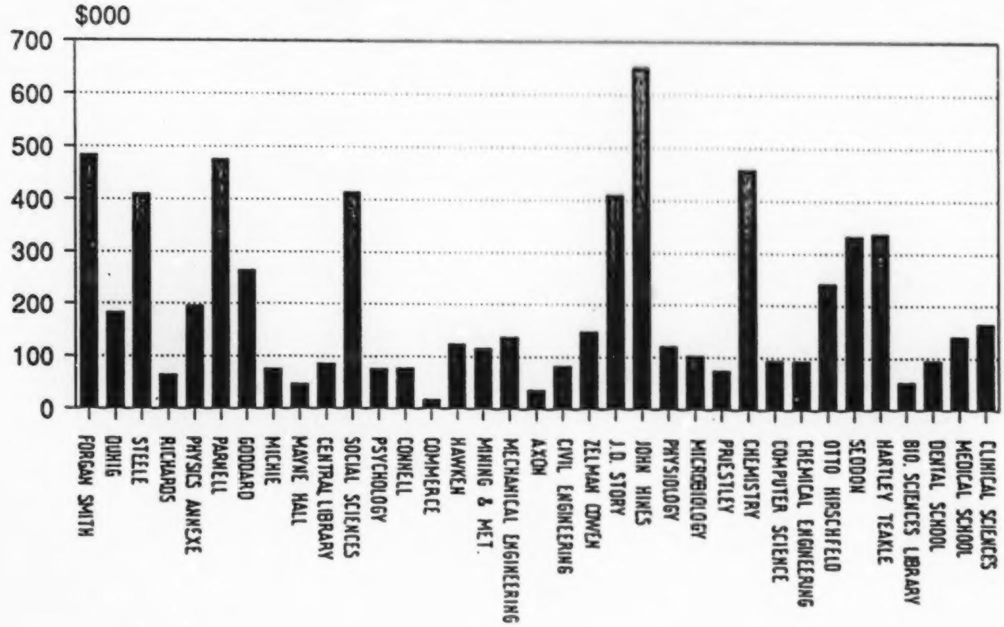
Appendix 1A

DM IMMEDIATE



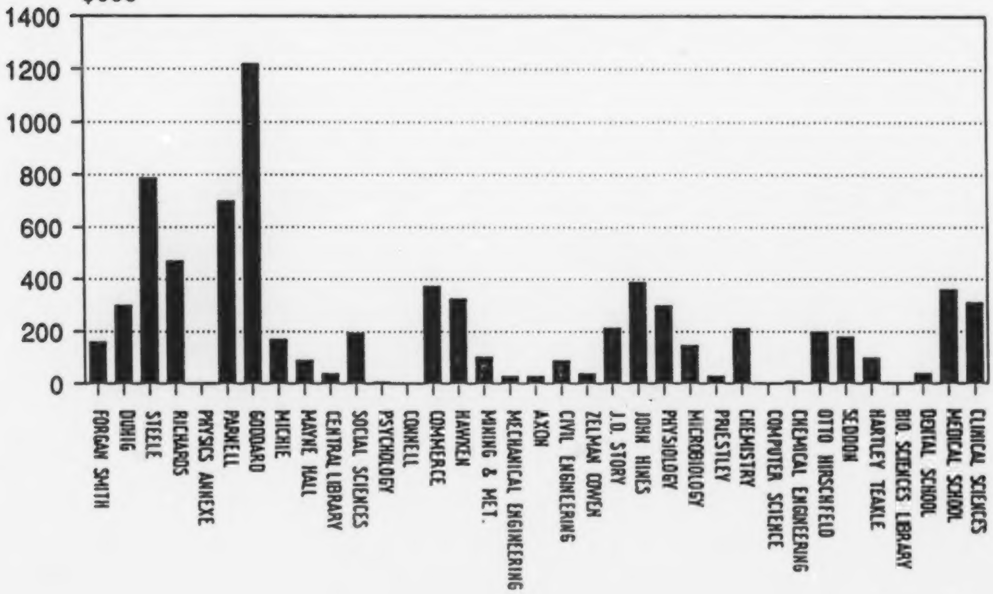
Appendix 1B

DM 2-5 YEARS



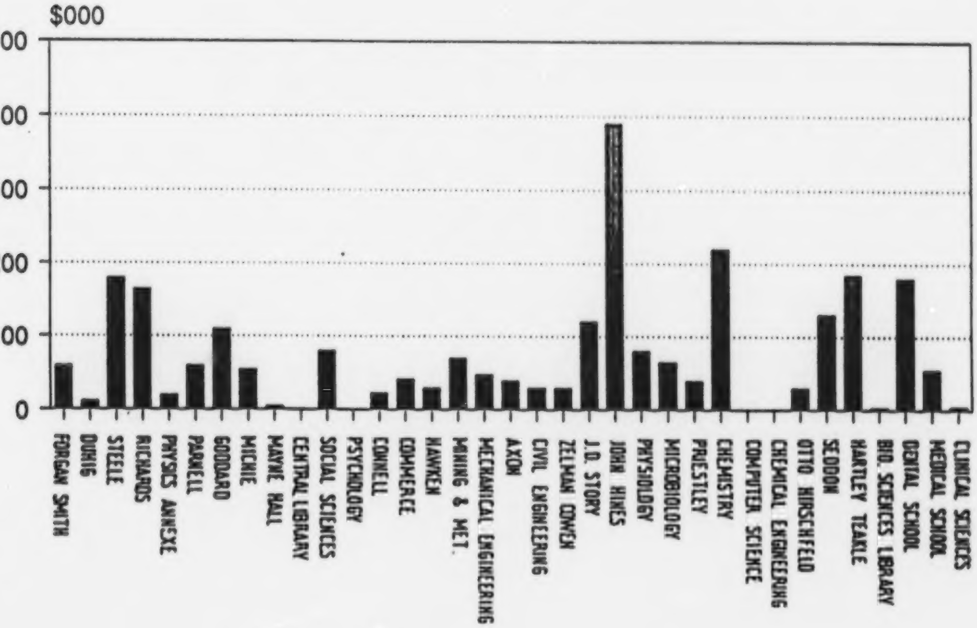
Appendix 1C

REHABILITATION



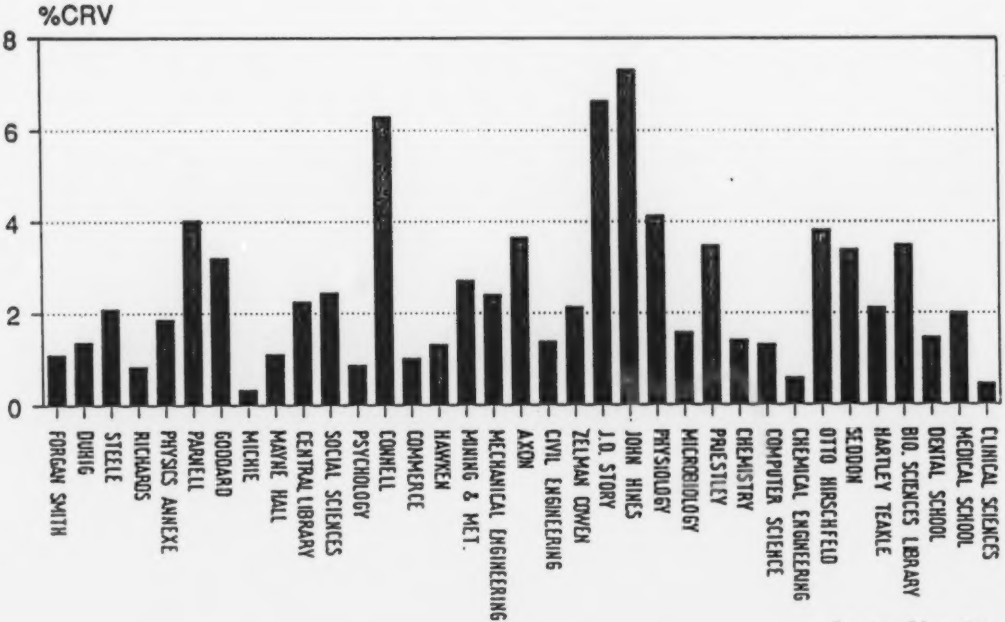
Appendix 1D

REHAB STATUTE



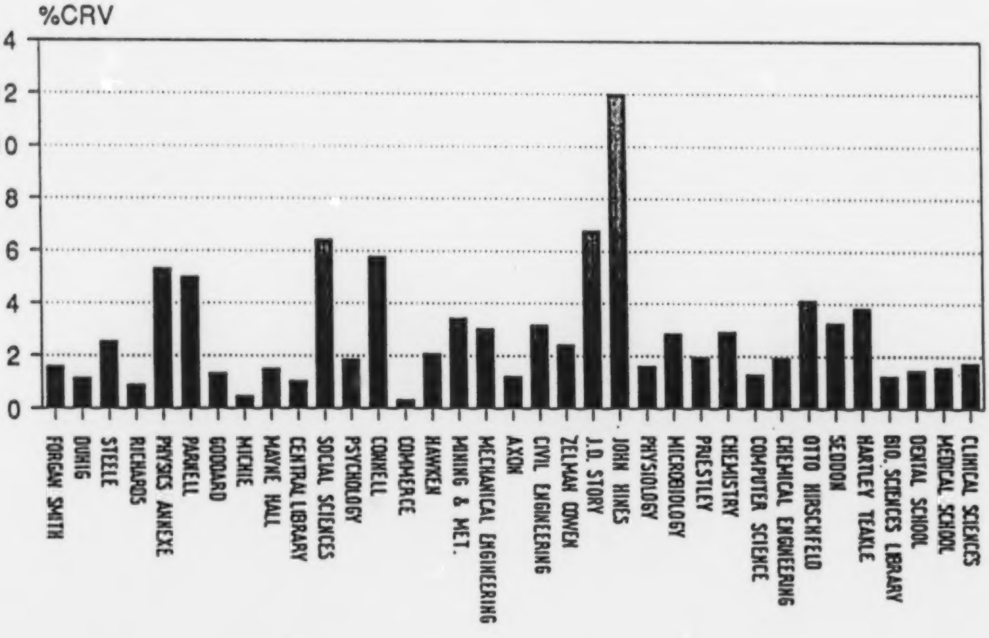
Appendix 2A

DM IMMEDIATE



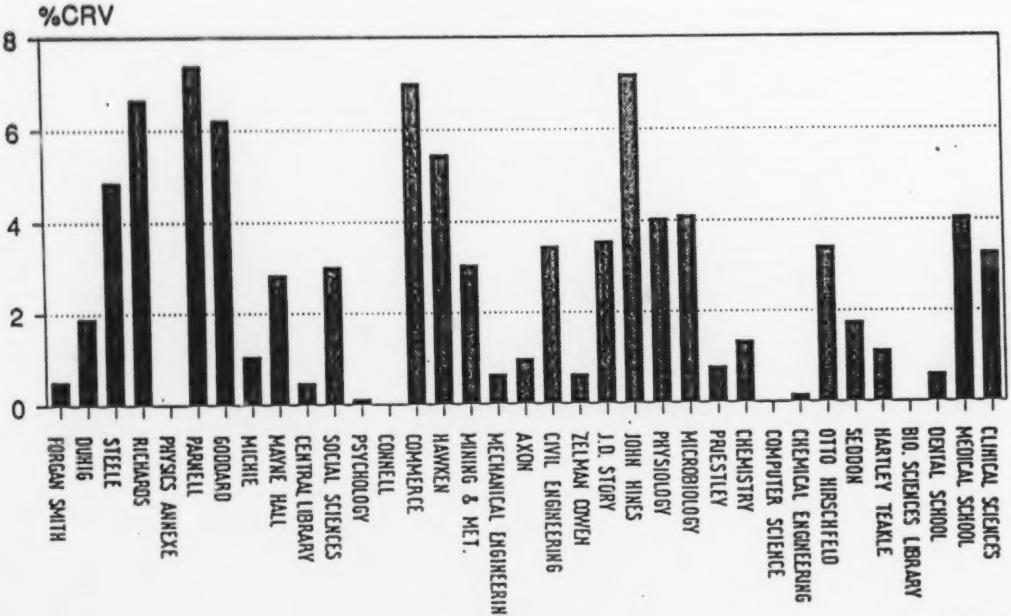
Appendix 2B

DM 2-5 YEARS



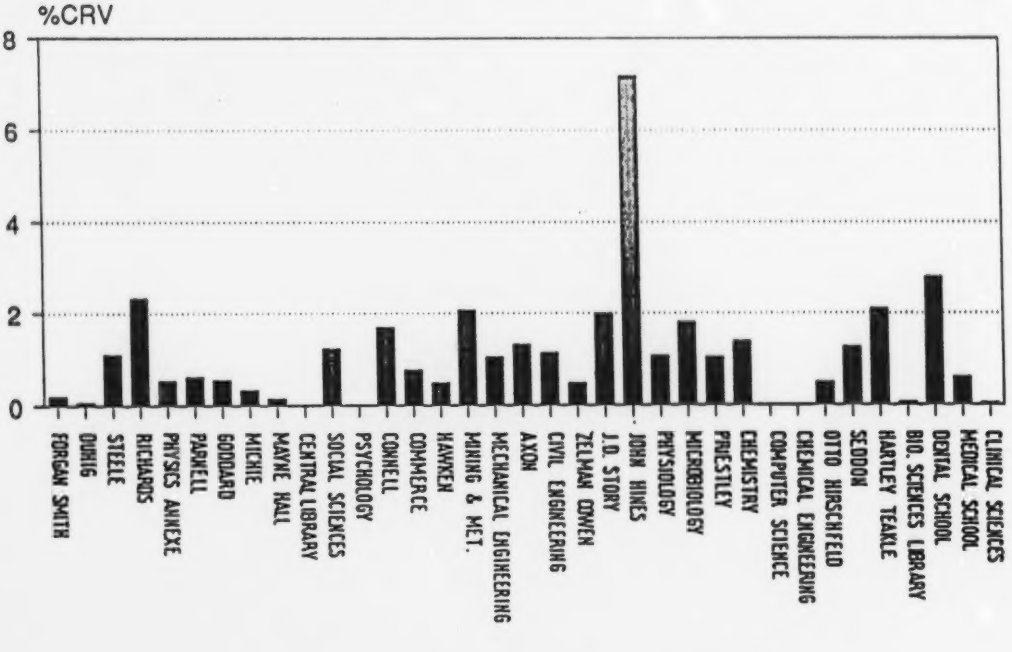
Appendix 2C

REHABILITATION



Appendix 2D

REHAB STATUTE



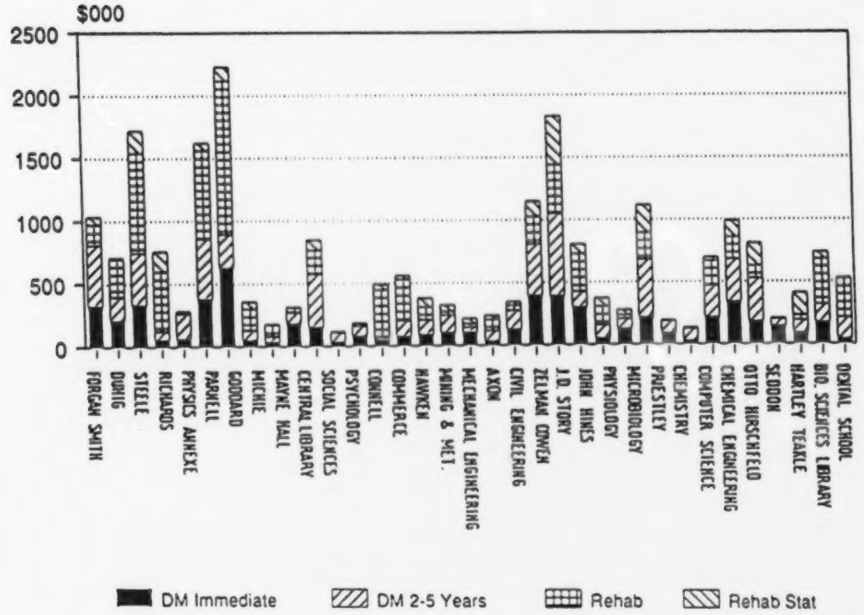
Appendix 3

MAINTENANCE AND REHABILITATION BUILDING SUMMARY
BUILDINGS OVER 2000M2 GFA
(THOUSAND $)

NO.	NAME	CRV	DM IMMEDIATE	DM 2 - 5 YRS	REHABILITATION	REHABIL-ITATION STATUTORY
001	Forgan Smith Building	29903	330	484	160	60
002	Duhig Building	15730	216	183	300	12
003	Steele Building	16166	340	411	788	180
005	Richards Building	7066	60	65	470	165
006	Physics Annexe	3675	69	196	-	20
007	Parnell Building	9473	383	476	700	60
008	Goddard Building	19628	632	265	1220	110
009	Michie Building	15800	55	76	170	55
011	Mayne Hall	3148	35	48	90	5
012	Central Library	8252	187	87	40	0
024	Social Sciences Building	6443	159	415	195	80
024A	Psychology Building	4111	36	77	5	0
026	Connell Building	1346	85	78	-	23
035	Commerce Building	5353	55	18	375	42
042	Hawken Building	5948	79	124	325	30
043	Mining & Met Building	3372	92	116	103	70
045	Mech Engineering Bldg	4519	109	137	30	48
047	Axon Building	3002	110	37	30	40
048	Civil Engineering Bldg	2603	36	83	90	30
051	Sir Zelman Cowan Bldg	6105	131	148	40	30
061	J.D. Story Building	6022	400	410	215	120
062	John Hines Building	5424	397	651	390	390
064	Physiology Building	7405	306	120	300	80
065	Microbiology Building	3591	57	102	148	65
067	Priestley Building	3788	132	75	30	40
068	Chemistry Building	15726	222	459	213	220
069	Computer Science Bldg	7150	95	95	-	-
074	Chemical Engineering Bldg	4866	29	94	8	-
081	Otto Hirschfeld Building	5840	224	242	200	30
082	Seddon Building	10197	346	333	180	130
083	Hartley Teakle Building	8787	187	338	100	185
094	Biological Sciences Library	4273	150	53	-	3
xxx	Moggill Farm	2655	606	552	160	34
861	Dental School	6426	95	95	40	180
881	Medical School	8863	179	141	361	55
901	Clinical Sciences	9405	45	165	310	5
xxx	Grounds/External Services	N/A	483	210	800	0

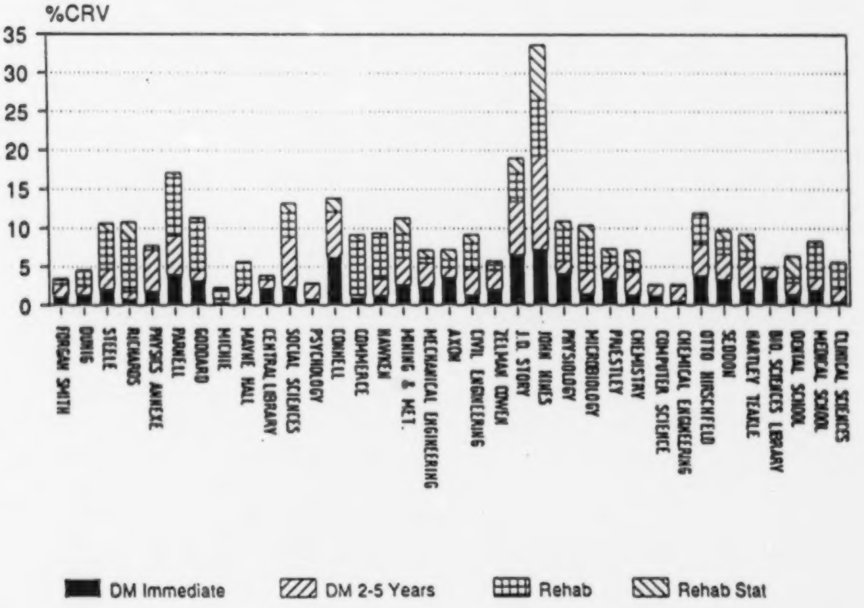
Appendix 4A

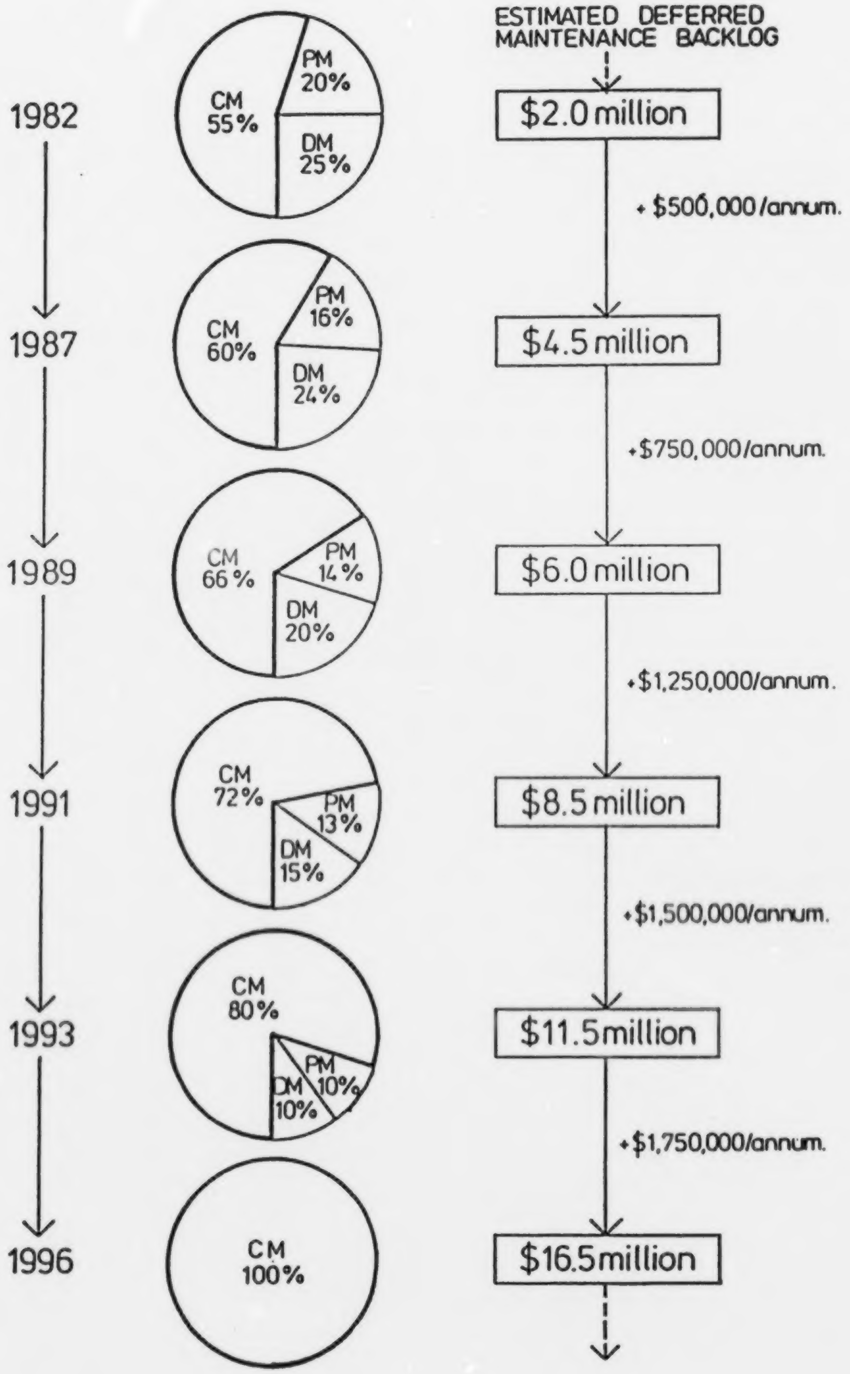
BUILDING SUMMARY



Appendix 4B

BUILDING SUMMARY

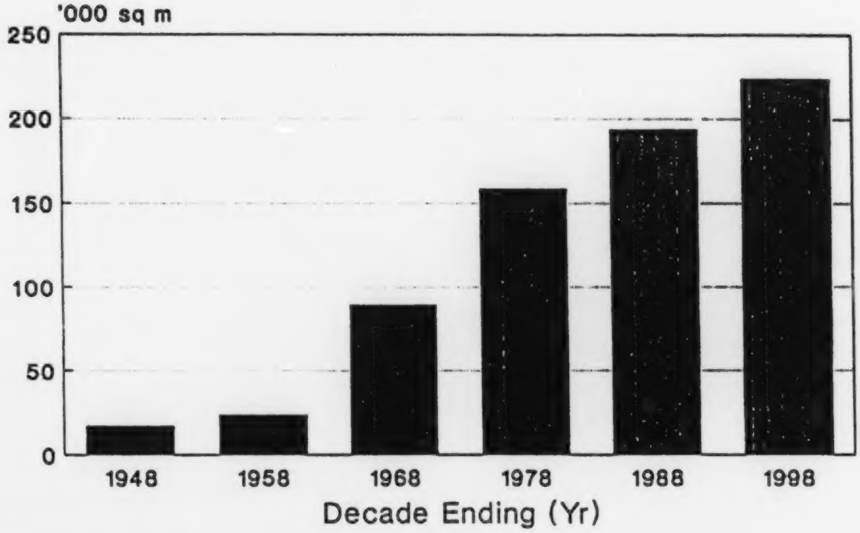



ESTIMATED DEFERRED MAINTENANCE BACKLOG
1982
CM 55%
PM 20%
DM 25%
$2.0 million
+ $500,000/annum.
1987
CM 60%
PM 16%
DM 24%
$4.5 million
+$750,000/annum.
1989
CM 66%
PM 14%
DM 20%
$6.0 million
+$1,250,000/annum.
1991
CM 72%
PM 13%
DM 15%
$8.5 million
+$1,500,000/annum.
1993
CM 80%
PM 10%
DM 10%
$11.5 million
+$1,750,000/annum.
1996
CM 100%
$16.5 million

Appendix 6

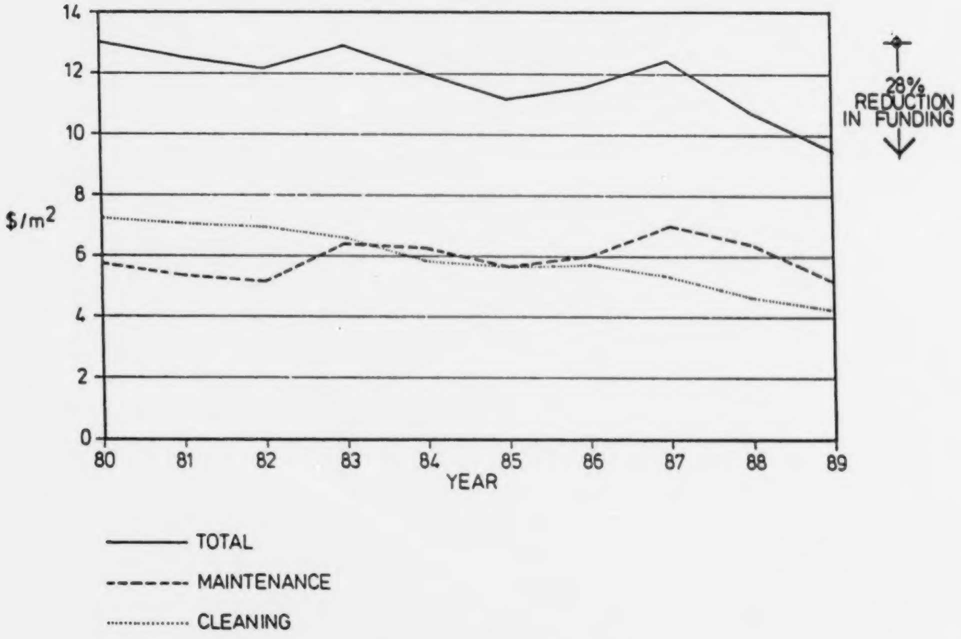
BUILDING STOCK

GFA(sqm) - St Lucia Campus

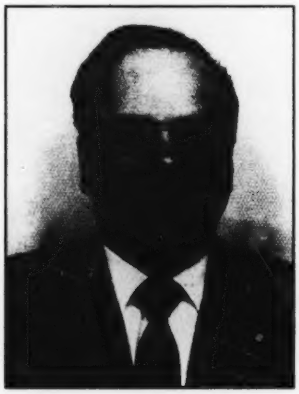


B&G 1988

Appendix 7



MAINTENANCE & CLEANING COSTS / m^2
1980 - 1989 (Real dollars - 1980 base)



The General Building Preservation Plan

Pierre Fleurant
Assistant Director, Building Services
Universite du Quebec a Montreal

1. PRESENTATION OF THE UNIVERSITY MAINTENANCE MANAGEMENT SYSTEMS (U.S. 20)

A city within a city.

The Université du Québec à Montréal occupies 2 500 000 square feet of space densely populated by 40 000 people. A collection of 17 buildings spread over the downtown area which they have to manage and maintain.

In all, 7000 rooms and offices which serve as support and physical framework for academic life. Facilities which must meet the standards of modern comfort and public safety.

The Building and Equipment Service of UQAM, with its 120 employees, is responsible for the preservation and maintenance of these buildings.

The security service, support services, and the technical services allow the Building and Equipment Service to perform its task of preserving and maintaining the value of UQAM's investments, estimated at about 170 million dollars.

In 1987, after three years of preparation, the administrators of the Building and Equipment Service adopted the General Building Preservation Plan (U.S. 20), which allows them to take a global approach to their management activities.

The objectives of the General Building Preservation Plan (U.S. 20) are as follows:

a). to maintain the premises in good condition;
b). to distribute evenly over time the expenses related to building maintenance;
c). to prolong the useful life of the buildings and electro-mechanical equipment;
d). to reduce the frequency of interruptions in the operation of critical equipment;
e). to ensure that electro-mechanical systems function at maximal output;
f). to reduce and eliminate dangerous situations;
g). to plan corrective action;
h). to maintain and improve the esthetic aspect of the buildings.

In addition to managing 18 000 service calls per year, the Plan allows the administration to evaluate, plan, organize, perform required tasks or have them performed, and control and follow up all operations in accordance with the mandate of the Building and Equipment Service.

The U.S. 20 contains many technical files. These files contain all the plans and specifications for each of UQAM's buildings. The U.S. 20 is also use to manage rented buildings.

The Plan allows for the accumulation of information from six different sources:

1. the environment,
2. the users,
3. the reports on deferred work,
4. the technical files,
5. progress reports,
6. miscellaneous sources.

This mass of information is constantly updated and is distributed within 15 specific action plans.

From key management in plan 1 to roofing in plan 15 through sanitation, health and safety, protection, janitorial maintenance, vehicles, energy management, paint and curtains, glass surfaces and floor coverings, stone-work and windows, fluorescent lights, ceiling tiles and furniture, landscaping, traffic signals, and operation and control of electrical, plumbing, and heating systems, these specific plans (SPs) cover in detail all fields of activity of the Building and Equipment Service.

The specific plans are the hub of to the U.S. 20. They keep track of a variety of factors, such as the shelf life of materials, maintenance and restoration costs, the frequency of replacement and maintenance, and the deterioration of equipment.

As an example, SP 15 (roofing) keeps a record of all data concerning the structural componants of each of the 148 drainage basins covering the UQAM buildings. It also integrates data from the annual inspection reports on the condition of the roofs. Analysis of the data from these various sources allows the adminstrator of SP 15 to precisely determine, for each of the 148 basins, the frequency and cost of each type of action necessary in inspection, repair work, and/or restoration, considering the technology and materials used.

This type of operational research characterizes all the SPs. It allows a planning supervisor to elaborate and present to the administrators of the Building and Equipment Service timely budgetary proposals and plans of action to fill the users' needs in relation with the constraints to each building.

With the aid of a central database and 12 management software packages, the direction of the Building and Equipment Service simultaneously analyses the impact, over a period of five years, of the 15 plans of action submitted by each specific plan managers.

This type of regular planning over five years, supplied with annual budgetary proposals and plans of action, facilitates the uniform distribution of expenses over time and the proper scheduling of major projects.

It is now possible for the direction of the Building and Equipment Service to put together final budgeted plans that will be executed or supervised by its employees.

Progress reports will make it possible to follow work being carried out and to report all modifications to the technical files, the specific plans, and finally to the U.S. 20.

By managing and directing the efforts of all the Building and Equipement Service Staff, U.S. 20 helps optimise all conservation and maintenance activities while maintenaing comfort for all building users.

2. CRITICAL PROBLEMS IN MANAGEMENT

Buildings are structures that must be preserved...

The external and internal structure of buildings are subject to periodic maintenance: remodeling and restoration of exterior structure (roofs, walls, doors, and windows) and interior structure (ceilings, walls, doors, floors).
What should be inspected and when? What should be done and when? At what cost?

Buildings are real estate. They have commercial value...

Some buildings are owned; others are rented. They must conform to various government regulations.
What should be inspected and when? What should be done and when? At what cost?

Buildings fill various needs...

As a result of the activities housed in the premises (mechanical workshops, laboratories, offices) and also of normal wear on them, their structures and support systems (electricity, heating, air-conditioning) will eventually wear out, and occasional or continuous servicing will be necessary. In addition, mail, messenger, and transportation services are required.
What should be done and by whom? Is the available personnel sufficient to meet needs? How should needs be forecast and met?

Buildings effectively protect goods and people...

The safety of persons within the buildings is of utmost importance.
What should be protected and insured? How, when, and by whom? What should be done in emergencies (fire, flood)?

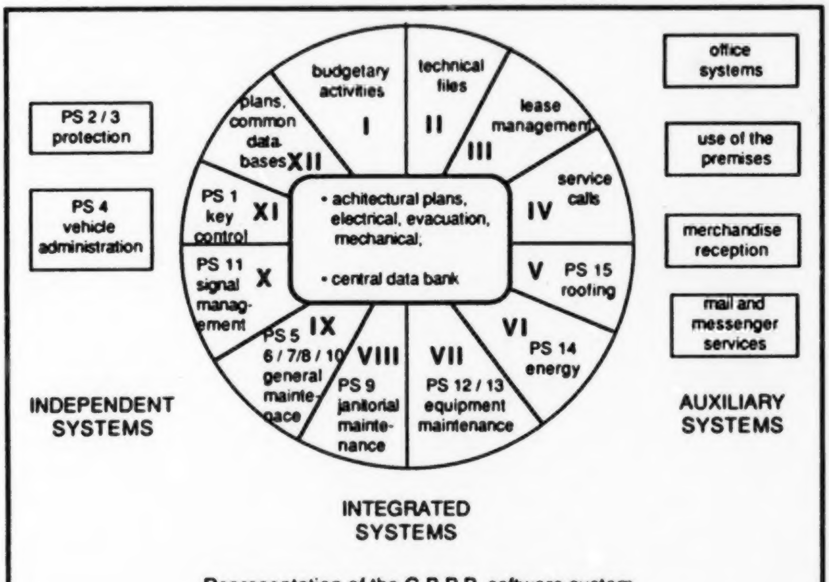
These are some of the many questions that must be answered every day in order to maintain the safety and comfort of all the occupants of one or more buildings, whether these buildings are owned or rented.

In short, the life of a building depends on its owners and users. A well-maintained building is a safe and productive workplace; if it is better preserved its value increases. A building is an investment.

3. MAINTENANCE FOR PRESERVATION

In order to maximize service to occupants, increase maintenance productivity by a better sceduling of activities, and maintain the equipment and increase the property value, administrators must have complete knowledge of recurring costs and adjust budgetary plans accordingly; hence the importance of a decision-making tool for operational and budgetary planning of preservation activities: the General Building Preservation Plan (U.S. 20).

The U.S. 20 is composed of twelve (12) micro-computer programs (I to XII) within a local network (see Figure 1). The systems are integrated or independent, depending on whether or not they are linked to the central data banks and the architectural, electrical, evacuation, and mechanical plans of the buildings. Some programs make use of the specific plans (SPs); others do not.



budgetary activities
I
technical files
II
lease management
III
service calls
IV
V
PS 15 roofing
VI
PS 14 energy
VII
PS 12 / 13 equipment maintenance
VIII
PS 9 janitorial mainte-nance
IX
PS 5 6 / 7/8 / 10 general mainte-nance
X
PS 11 signal manag-ement
XI
PS 1 key control
XII
plans, common data bases
• achitectural plans, electrical, evacuation, mechanical;
• central data bank
PS 2 / 3 protection
PS 4 vehicle administration
INDEPENDENT SYSTEMS
office systems
use of the premises
merchandise reception
mail and messenger services
AUXILIARY SYSTEMS
INTEGRATED SYSTEMS

Representation of the G.B.P.P. software system

Figure 1.

3.1. INTEGRATED SYSTEMS

I. Adminstration of budgetary activities

Written in TurboPascal, this program constructs a zero-based budgetary estimate, separately evaluates each cost, and controls activities spread over long terms, such as major contracts.

II. Administration of the building conservation plan (technical files)

Written in LOTUS 1, 2, 3, this program characterizes each building according to the 15 specific plans and collects the inventary data about the premises from the corporate files. From these data, it calculates the annual expenditure for each preservation activity and stores the results in a technical file.

III. Lease management

Written in dBase III + compiled, this program exercises budgetary control over rentals. It records the clauses and contractual obligations of lessees, as well as their analytical and descriptive elements (address, space occupied, coordinates of the lessor or superintendant). It gives a calendar of events (effective dates and expiry dates of the leases, deadlines for escalatory clauses, cancellation, billing or payment, sending of notices) and separately evaluates the various fees.

IV. Administration of service calls

Written in dBase III + compiled and accompanied by a report generator, this program rationalizes maintenance management and maximizes service to occupants. It records service calls by category (electricity, floor repair, water) and dispatches them accordingly. It updates the occupation of the premises on a weekly basis. It indexes the progression of the measures taken in answer to each call. It produces statistics.

V. Administration of roofing (SP 15)

Written in dBase III + compiled and accompanied by a report generator, this program rationalizes maintenance management and maximizes the preservation of materials according to need for roofing maintenance. It records the characteristics of the roofs (composition, joist, membrane, insulating material) and produces the annual budgetary cycle of the maintenance (from the visual inspection and the balance sheet to the budgetary estimate of work to be done). It ensures supervision and manages warranties. It constructs a maintenance budget, taking into account the selected methods and materials.

VI. Energy management (SP 14)

Written in dBase III + compiled and accompanied by a report generator, this program facilitates energy management and maximizes the supply of various sources of energy. It records and manages the energy supply (electricity, fuel oil, gas) according to demand as shown on the meters. It compares the suppliers' invoices with actual consumption. It produces statistics and graphs of consumption.

VII. Equipment maintenance management (SP 12 and SP 13)

Written dBase III + compiled and accompanied by a report generator, this program plans and orders the equipment maintenance (wiring, filters, oil, air vents, air-conditioner) and maximizes the useful life of the equipment. It identifies stock levels, determines plans of action, and records work performed. It levels the work loads of the various trades and produces statistics.

VIII. Janitorial maintenance management (SP 9)

Written in Micro Cobol, this program plans and orders the janitorial maintenance of the premises (washing, wiping, sweeping, waxing, dusting, emptying the ashtrays) and maximizes their useful life. It records data for various inspection tours. It updates on a weekly basis the surface area to be maintained, produces the frequency of daily work loads per week, and validates the progress of the work. It adjusts the cost's forecast in the budget in relation to real costs.

IX. Administration of the general maintenance of the premises (SP 5, SP 6, SP7, SP 8, and SP 10)

Written in Basic compiled and in LOTUS 1, 2, 3, this program facilitates the administration of the general maintenance of the premises and maximizes their useful life. It records general maintenance activities (stone-work, painting, curtains), does the budgetary follow-up, produces the frequency of work loads, and validates the progress of the work.

X. Traffic signal management (SP 11)

Data retrieval program for the fabrication of identification plates for the premises and direction indicator plates.

XI. Key control (SP 1)

Written in dBase III + compiled, this program identifies the normal door number and location of keys as well as the master and sub-master keys and the individuals in whose possession they are to be found. It manages the distribution and control of keys to the premises,

XII. Administration of plans and common databases

Collection of data belonging to the fifteen specific plans and the integrated systems.

3.2. INDEPENDANT SYSTEMS

a. Administration of protection (SP 2 and SP 3)

Micro-system which manages security material. It manages guard activities and produces statistics on incidents.

b. Vehicle administration (SP 4)

Written in dBase III + compiled and accompanied by a generator of reports, this program facilitates management of vehicle use. It prepares the vehicle inventory, records maintenance jobs (oil changes, tire changes) and records costs. It calculates the economic point of replacement for a vehicle and produces statistics.

3.3. AUXILIARY SYSTEMS

The U.S. 20 can be connected with other software systems not directly implicated in the maintenance and preservation of buildings and equipment.

a. Administration of use of the premises

The program lists and offices which are in use and those which are not. This information is used for planning purposes (occupants, purpose and length of occupation, locking and unlocking of doors).

b. Management of merchandise reception files

The program manages central receiving. It updates the various files (refusals, returns, research, receipts) and is linked to the purchase and finance systems.

c. Mail and messenger services

The program manages, sorts, and directs internal and external sending and records the cost of stamps. It is linked to the finance system.

4. ARCHITECTURE OF THE U.S. 20

Conceived for use on IBM or on IBM-compatible computers, the U.S. 20 makes it possible to forecast and solve all problems dealing with maintenance and preservation of buildings. This is possible due to the integration of its three basic elements: the general plan, the specific plans, and the technical files.

4.1. The General Plan (GP)

The GP is the frame of reference for job planning. It is a representation guide of the collection of tasks to perform: *evaluate, plan, organize, execute or contract out, and control.* First of all, the administrator identifies the needs and resources--he *evaluates*. He determines the fields of intervention and estimates their budgets--he *plans*. He selects certain plans of action--he *organizes*. He initiates activities--he *executes or contracts out*. He ensures that the tasks are performed and checks the quality of the results--he *controls*.

4.2. The Specific Plans (SP)

Each SP is a tool for detailed planning and budgeting of maintenance tasks. It keeps track of the complementary work load ordered by the service call and inspection tour management system. Fifteen in number, the SPs deal with the following aspects:

SP 1 Locksmithing
-hardware items for the building doors;
-distribution and tracking of keys.

SP 2 Sanitation, health, and safety
-health and safety measures at work;
-emergency measures teams;
-fire alarms;
-fire-fighting equipment;
-evacuation plans;
-safety regulations in the laboratories and workshops.

SP 3 Protection
-guard activities;
-electronic surveillance devices;
-investigations.

SP 4 Vehicle management

-motor vehicles.

SP 5 Paint and curtains

-painted surfaces;
-curtains.

SP 6 Glass surfaces and floor coverings

-glass surfaces;
-floor coverings.

SP 7 Stone-work and window-work

-interior and exterior stone surfaces (brick, stone, concrete);
-window-work and waterproof joints.

SP 8 Fluorescent lights, ceiling tiles, and furnishings

-fluorescent lights and ceiling tiles;
-furnishings and accessories;
-paintings, art work.

SP 9 Janitorial maintenance

-outside contracts for maintenance of the premises;
-sanitation contracts (garbage collection and extermination);
-inspection reports.

SP 10 Landscaping and urban furnishings

-lawns, trees, and flowers;
-bicycle stands, exterior trash cans, exterior drains.

SP 11 Traffic signals

-signs.

SP 12 Operations and control

SP 12.1 Ventilation, air-conditioning, heating

-water systems (steam and air-cooling);
-boilers, burners, special air-conditioners (computers, animal house);
-detachable air-conditioners.

SP 12.2 Control systems

-fire alarm systems;
-thermostatic controls;
-electronic systems.

SP 12.3 Electricity

-systems for the internal distribution of electricity;
-generating sets.

SP 12.4 Plumbing

-toilets, sinks, urinals, and related plumbing;
-floor drain systems;
-sewage systems (for sanitation and rainfall);
-distribution of demineralized and distilled drinking water;
-gas supply system.

SP 12.5 Refrigeration

-kitchen and laboratory equipment.

SP 12.6 . Elevators and escalators

-elevators and escalators;
-air doors and freight elevators;
-special locks;
-delivery tricycles;
-other special equipment.

SP 13 Preventive maintenance

-work orders generated by the six preceding sub-plans;
-work schedule.

SP 14 Energy management

-statements and invoices;
-energy management norms.

SP 15 Roofing

-roofing management norms (materials and methods for inspection, restoration, and repair);
-work orders;
-annual summary of the condition of the roofs;
-long term projection of restoration and repair costs.

Service call management (services the fifteen specific plans)

-service calls;
-work orders.

4.3. The technical files (TF)

Produced from automated information banks, each technical file characterizes an owned or rented building according to the fifteen specific plans.

5. PROFITABILITY OF THE U.S. 20

5.1. FLEXIBLE AND INNOVATIVE — IT IS EASY TO USE

Designed for the adminstrator with a limited knowledge of computers, the U.S. 20 comes with the technical documentation and a user's guide. It is easy to learn since the learning process is the same for all programs.

The U.S. 20 is modular and could be connected to a local network. It accepts CAC (computer aided conception) and CAD (computer aided design) environments and can process a large amount of management data. It also has the advantage of functioning as micro distributed processing or on a micro-computer, thus maximizing the various computer systems available.

5.2. STRATEGIC MANAGEMENT TOOL — IT INCREASES CONTROL

The U.S. 20 is a user-friendly decision-making tool because of its simplicity of use. It increases the productivity of administrators responsible for the maintenance and preservation of buildings. It assists the adminstrator in all strategic decision processes by allowing him to budget for the preservation of each building or piece of equipment over five, ten, or fifteen years in constant dollars.

From certain aspects outlined by the U.S. 20 (realization calendar, plan of action, and associated costs), the adminstrator picks the highest priority actions to budget for and undertake.

An overview of the status and evolution of the various specific plans is available at a glance. The U.S. 20 allows the administrator to plan in advance in order to meet the needs of the organization.

6. CONCEPTION OF THE U.S. 20

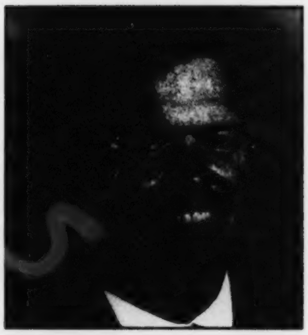
The Building and Equipment Service (B.E.S) of the Université du Québec à Montréal conceived, perfected, and is now utilizing the U.S. 20 from its 10 years of experience, the B.E.S. manages, maintains, and preserves 17 buildings with a total surface area of 2 500 000 square feet and occupying more than 7000 rooms and offices in downtown Montreal.

1979 The B.E.S. installs on micro-computer a first automated preventive maintenance management system for equipment.

1984 The B.E.S. implements the first independent systems on microcomputer: the janitorial maintenance system and the service call system.

1986 The B.E.S. undertakes a three-year plan for the development of computer systems, leading to the implementation of independent systems.

1987 The B.E.S. completes the conception of the **General Building Preservation Plan** and the methodology for the integrated administration of specific maintenance plans and independent systems.



Physical Plant Performance Evaluation Pulse Points

Robert L. Allen
Assistant Vice President For Facilities
Northern Arizona University

Introduction

The ability of some organizations to self-evaluate their condition has been an item of concern since the industrial revolution. The problem then, as now, was how does the manager select and use meaningful measures of merit that will gauge the health of organization? The latest APPA "Facilities Management Handbook" identifies "a control system that regulates, accomplishes and accommodates the measurement of maintenance activity" as an essential element of the basic objectives of maintenance management. The handbook also recognizes the need for "establishing a meaningful performance measurement system and a quality control function." To accomplish one of the basic objective's essential elements, certain performance indicators need to be used in a meaningful way.

Last year at the seventy-sixth (76) APPA Annual meeting a presentation was made on the newly introduced APPA Self Evaluation System as a part of the Facilities Management Evaluation Program Service. The system consisted of thirty-five (35) elements of organizational review within nine (9) topics of self-evaluation. Each of these element reviews require a somewhat detailed written analysis. Therefore, the completion of the entire APPA's formal Self-Evaluation Analysis entails a very time consuming effort. As a result, it would tend to only be undertaken not more than once per year. As an additional supplemental tool to be used in the evaluation process, a system of self-applied monthly performance indicator's calculation charting and analysis is recommended. The performance indicator system could then be used by Physical Plant organizations to measure their own performance against generally recognized and/or locally developed targets/goals. Taken in aggregate this on-going review becomes an effective, easily applied self-evaluation tool.

Accordingly, this presentation attempts to identify some of those performance indicators (PI's) that might be used to monitor the progress of Physical Plant activities. The presentation will consist of two (2) parts. Part one addresses the experience of our colleagues in Australia. Their Facilities Managers have been collecting and exchanging PI's for years. On the other hand, Physical Plant Administrators in North America have intuitively used "rules of thumb" to informally analyze the "how goes it" aspects of certain activities within their organization. Generally, these pulse points have not been formally identified or published. The second part of the presentation suggests some possible new ways of looking at Physical Plant Management pulse points. It gives information on how to obtain the needed data, plus once displayed, how to analyze each as a performance indicator. As a result, when used in aggregate, the application of the performance indicator system can serve as an ongoing supplemental self-evaluation system.

The American Experience

The Need. As we mentioned in the Introduction, the Physical Plant organizations in North America do not have as formalized a performance indicator program to provide an on-going evaluation of the pulse of their activities as our friends in Australia. Generally directors/administrators have used "rules of thumb," "intuition" or "gut feelings" to estimate the condition of their organizations. In the age of slide rules/calculators, typewriters, T squares, Thermofaxed and butcher paper chart briefings, this was generally the best they could do unless they have such large organizations that they could devote a large staff to "management analysis" activities. However, now in the age of multimegabite personal computers, data faxes, laser printers and soon compact disk read/write many times data storage devices such as a commitment of manpower resources is not required to establish and maintain a very powerful on going self-evaluation set of tools. Managers can now select and use performance indicators that are fairly accurate judges of the condition of their organizations. With the tools now available they can set about identifying the pulse points within their data collection system that they will need to analyze their condition without a lot of the old written discussions. Where data doesn't currently exist they can develop ways to generate that data fairly easily. Once the data collection system is established and functioning, managers can then set about developing techniques to evaluate and/or graph the data using the tools of trend analysis, upper lower limit set-points, goal achievement evaluation, production count, down time rates, back log review and many other types of management analysis. The aggregate of these reviews would then give a relatively good indication of the condition of their organization.

A Suggested Way. While at Lamar University in Beaumont, Texas and following on at Northern Arizona University in Flagstaff, Arizona, I have tried to pursue these concepts to the point that a pulse point system could be developed and utilized. Unfortunately, I didn't have time enough at either place to fully develop and implement the system. However, it is not the point of this presentation to convince you to buy into my evaluation tools. My purpose is to suggest the idea of a system of on-going evaluation and by showing you some of my ideas so that as we jointly progress on to an APPA consensus on-going self-evaluation system that could be published for all to use. With that in mind let's look at some of the possibilities.

Physical Plant Performance Indicators. The following twenty four (24) performance indicators represent some of the possibilities. The first six (6) have been graphed to illustrate the ways analysis could be performed.

1. **Shop Schedule Compliance**

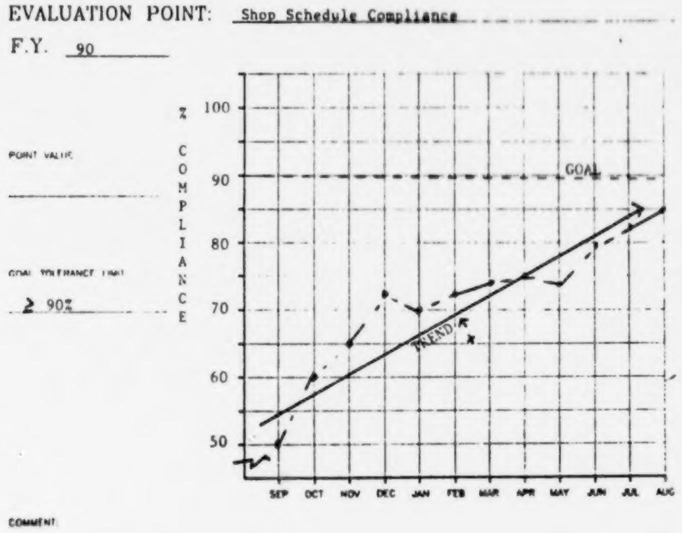
a. Gives percent of compliance with published shop schedules

b. Computed by determining ratio of:

[Actual Manhours (Mhrs.) Worked]
(Total Mhrs. Listed on Schedule)
-Calculated by adding the manhours worked on or before the date they were scheduled and dividing by the total hours scheduled. Do not count hours spent on a job that are in excess of the estimated or scheduled hours for that job.

c. Acts as a pulse point for the quality of an organization's shop schedule. Serves as an indicator of customer commitment.

d. Analyzed by graphing as follows:



2. **P.M. Task Completion**

a. Reports percent Preventative Maintenance Task accomplished to date.

b. Computed by determining ratio of:

(No. of P.M. Tasks Completed to Date)
(No. of P.M. Tasks Scheduled to Date)

c. Serves as a pulse point to gauge the quality of the Physical Plant Preventative Maintenance program, indicates the degree of commitment to the first line of facilities maintenance defense - preventative maintenance.

d. Analyzed by comparison with goal and trend(s) of the compliance line.

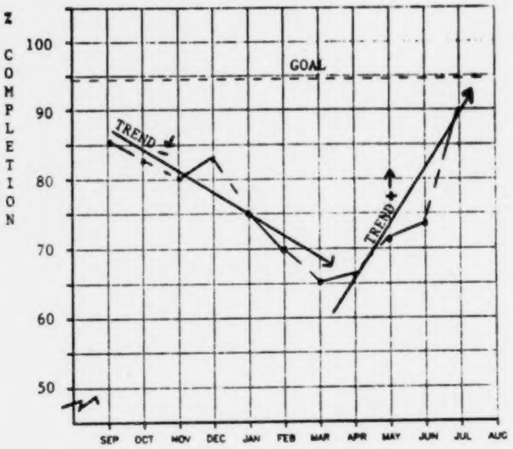
EVALUATION POINT: P.M. Tasks Completion

F.Y. 90

POINT VALUE

GOAL TOLERANCE LIMIT

≥ 95%



COMMENT:

3. **Change Order Rate**

a. Comparison of Total Dollar Value of construction and /or renovation change orders vs. Total Dollar Value of construction and renovation involved.

b. Computed by determining ratio for:

$$\frac{\text{(Total Dollar Value of Change Orders to Date)}}{\text{(Total Dollar Value of Construction to Date)}}$$

c. Serves as a pulse point of the quality of design effort or the degree of outside interference. Can analyze by review of rates for in-house vs. consultant and/or construction vs. Renovation design experience.

d. Analyzed by comparing the rate to a predetermined organizational goal and trend inspection.

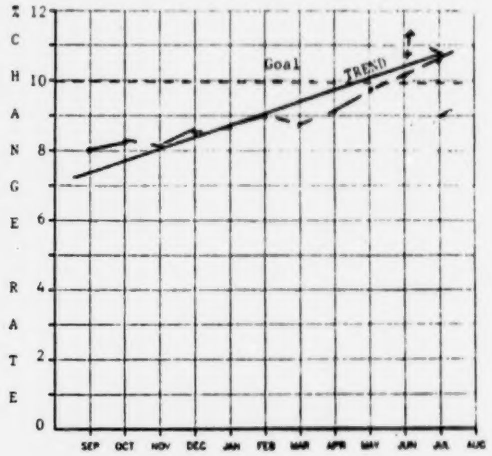
EVALUATION POINT: Change Order Rate

F.Y. 90

POINT VALUE

GOAL TOLERANCE LIMIT

10%



COMMENT:

4. **Major Equipment Incommission Rate**

a. Indicates percent of major equipment incommission rate

b. Computed by determining the monthly ratio of:

$$\frac{\text{(one (1) minus the ratio of the sum of each piece of down equipment's Rate Value x its downtime in \$)}}{\text{(Total Monthly Major Equipment Rate Value, TMMERV, in \$/month.)}}$$

--TMMERV = sum of each individual equipment rate values for each major equipment items x 24 hours/day x 30 days/month.

--Rate Value = $\frac{\text{(Total cost of Equipment)}}{\text{(Life Expectancy in Hours)}}$ in \$/hr.

c. Serves as a pulse point for quality of equipment maintenance program. Also serves as a gauge of condition of equipment.

d. Analyzed by review of the downtime rate vs the organization's goal. Serves as a good public relations tool at times. Do not include scheduled downtime for maintenance.

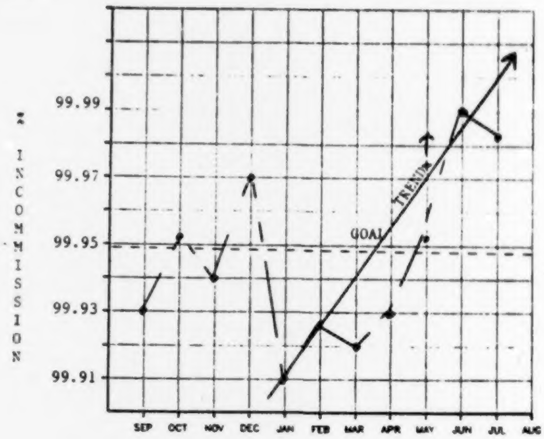
EVALUATION POINT: Equipment Downtime Rate

F.Y. 90

POINT VALUE ________

GOAL TOLERANCE LIMIT

≥99.95%



COMMENT:

5. **Shop Direct Time**

a. Tracks percent of direct time by shop

b. Computed by determining ratio of Shop Direct Hours vs Total Shop Hours

-- Direct Time = Total of Shops Hours (Number of Employees x 8 x 30) minus hours credited to leave, vacation, meetings, training, supervision, lag time, etc.

c. Serves as a pulse point for a shop's amount of direct hours available for productive work from month to month. Indirect times can be collected by establishing a Collection Work Order for each type of indirect time.

d. Analyzed by review of the percent of direct time versus a generally-accepted standard of 70% direct time as follows:

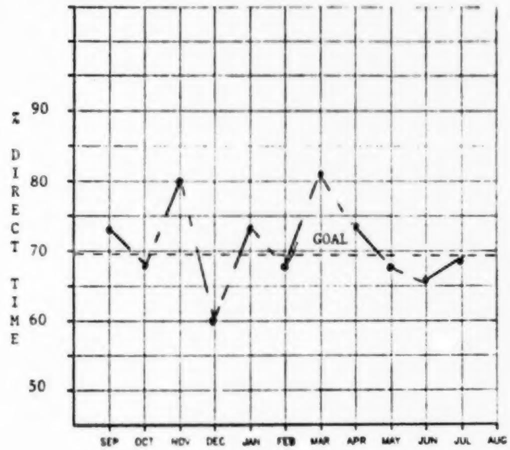
EVALUATION POINT: Shop Direct Time

F.Y. 90

POINT VALUE

GOAL TOLERANCE LIMIT

≥ 70%



COMMENT:

6. In-House Estimating Factor

a. Gives a percentage rate of Estimated vs Actual Cost for In-House Shop Work

b. Computed by determining the ratio of:

$$\frac{\text{(Sum of In-House Actual Costs for Completed Work Order in Current Month)}}{\text{(Sum of Estimated Cost of the Same Work Orders)}}$$

c. Serves as a pulse point for evaluating the ability of the inhouse staff to estimate work. Could possibly be used to judge the worker's productivity when generally recognized standards are used for the estimate.

d. Analyzed by comparison with a locally determined standard.

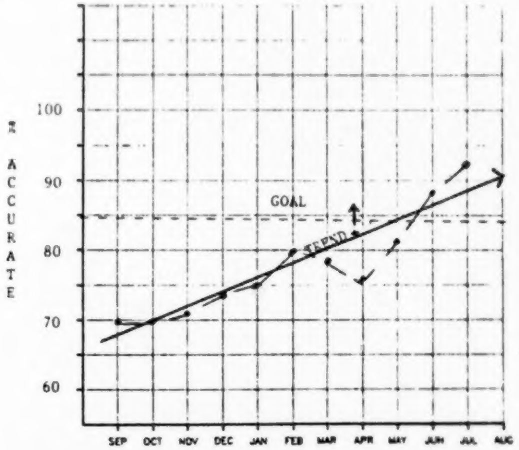
EVALUATION POINT: In House Estimating Factor

F.Y. 90

POINT VALUE

GOAL TOLERANCE LIMIT

≥ 85%



COMMENT:

7. **Work Order Backlog by Time Frame**

a. Used for identification of shop backlog by age of work

b. Determined by a count of work orders in the following age brackets: (1) 30 days to 60 days; (2) 61 days to 90 days; (3) 91 days and over. Information could also be displayed in number of total manhours in each category or when computed by the shop the number of shop months in each category. Shop months are calculated by dividing a shop's average number of direct hours into the category's total hours, (see number 14 below).

c. Used as a pulse point to judge in-house work completion effectively.

d. Analyzed by tracking the overdue items each month, or the number of manhours/shops months in each category.

8. **Deferred Maintenance Backlog Indicator**

a. Reports Total Dollar Value of Deferred Maintenance as determined by facility audits vs Total Facility Replacement Value.

b. Developed by use of facility audits and comparing aggregate to Facility Replacement Value.

c. Used as a pulse point to evaluate the organization's ability to eliminate its Deferred Maintenance.

d. Analyzed by following the trend of the rates and review of the total deferred maintenance.

9. **Quality Acceptance Rate**

a. Indicator of customer satisfaction with completed work orders.

b. Computed by determining ratio of Quality Control Evaluations by Calculating the:
(Number of Satisfactory and Better Ratings)
(Total Number of Evaluations Returned)

c. Used to determine the degree of customer satisfaction and identification of good or poor work practices.

d. Analyzed by plotting the % rates each month and observing the trend of the progress.

10. **Percent Facility Audits Accomplished**

a. Reports total percent of facility audits completed in last year.

b. Computed by determining ratio of:
(No. Facility Audits Completed Within Current Year)
(Total Number of Facilities)

c. Used to measure the organization's progress toward completion of facility audits.

d. Analyzed by reviewing the % of completion vs a predetermined goal (e.g. 33%)

11. Budget Compliance by Account(s)

a. Provides comparison of Budget Expenditures by Account vs the Original Budget plus Approved Changes

b. Done by use of one line graph for the budget and plotting the actual funds expended and committed.

c. Used to measure the organization's utilization of funds and ability to budget them accurately plus spend them wisely.

d. Analyze by comparing actual expenditures and possibility of encumbered funds vs the monthly budget projections.

12. Labor Material Ratio

a. Gives a ratio of material dollars used per each dollar of labor by shop

b. Usually expressed as two percentages e.g. 60%/40% (labor/material)
c. Used to evaluate the organization's ability to accomplish a wide variety of inhouse work, not just labor intensive work.

d. Analyze by comparing to a locally developed ratio e.g. 60% labor/40% material

13. Building Cost Per Square Foot

a. Calculation of the average yearly cost of operation, maintenance and repair per square foot of building space (not construction)

b. Calculated by ratio of:
(Total Yearly Bldg. O&M and Repair $)
(Total Building Sq. Footage)

c. Used to determine the relative condition of campus facilities. Could be used to assist in the review of deferred maintenance.

d. Analyzed by comparing the ratios and reviewing the trends by category of building.

14. Shop Work Backlog

a. Indicates the shop months of in-house work backlog

b. Calculated by:
(Total Manhours of Backlog of Existing
Non-Completed Work Orders

18. Physical Plant Accident Loss Time *vs* Hours Worked Rate

a. Used to measure effectiveness of safety efforts

b. Calculated by ratio of:

$$\frac{\text{(Total Mhrs. of Accident Related Loss Time)}}{\text{(Total of Mhrs. Available to Work)}}$$

c. Used as a pulse point to evaluate the efficiency of an organization's safety program

d. Analyzed by charting the ratios and comparing them to a locally determined standard. (e.g. .5%)

19. Bench Stock Empty Bin Rate

a. Measures the percent of empty bins (no material available) as measured on bench stock inventories ben counts at least weekly. Do not count emergency stand-by items, only count day to day bench/shop stock.

b. Calculated by ratio of:

$$\frac{\text{(No. of Empty Bin Days)}}{\text{(Total No. of Bin Days)}}$$

c. Used to determine the organization's ability to keep parts in stock that are needed by shops.

d. Analyzed by charting the monthly fill rate ratios *vs* a locally determined standards (e.g. less than 10%)

20. Warehouse Turnover Rate

a. Measures the ability of the warehouse to stock materials items that have the most need (use)

b. Calculated by ratio of:

$$\frac{\text{(Total Dollar Value Issued from Warehouse Stocks)}}{\text{(Total Dollar Value of all Warehouse Inventory)}}$$

-- Items issued does not include materials issued not in warehouse stock, i.e. items ordered from vendors and delivered to the job

c. Used to determine the organization's ability to stock needed materials

d. Analyze by comparing the organization's experience *vs* a standard (e.g. 4 turns per year)

21. Vehicle Obsolescence Rate

a. Indicates percent of vehicles over 8 years old or less than 8 years old and requiring expenditures for maintenance and repair in excess of 50% of current year's depreciated value

b. Calculated by ratio of:

(No. of Vehicles Over 8 Yrs. Old Plus No. of Vehicles Less than 8 Yrs. Old with Annual Maintenance & Repair Costs in Excess of 50% of Current Year's depreciated Value)
(Total Number of Vehicles)

c. Used to evaluate the organization's vehicle fleet condition

d. Analyze by comparing to an identified standard (e.g. less than 25% per year)

22. Average In-House Design Time Per $10,000 of Construction

a. Estimated factor used to determine rough amount of design time per $10,000 of designs accomplished.

b. Calculated by determining the ratio of:

(No. of Hours of Design Time)
(Dollar Value of Design/$10,000)

c. Used as a pulse point to measure the efficiency of inhouse design effort

d. Analyze by setting a standard for the ratio and comparing actual data to the standard

23. Energy Consumption in Various Utilities

a. Gives:

-- BTU's per square foot of bldg. space
-- Electrical KWH per square foot of bldg. space
-- Cubic feet of gas per square foot of bldg. space
-- Gallons of water per square foot of bldg. space

b. Used to evaluate an organization's energy conservation efforts

c. Analyzed by review of the trends of energy consumption per month per degree days

24. Workload by Skill/Craft Man Year

a. A measure of workload by unit of measure (e.g. by sq. ft., acre of grounds, tons of HVAC, etc.) by skill (e.g. Plumbing, Carpenter, HVAC mechanic, etc.) as compared to the APPA National Average for Schools of similar size and skill

b. Calculated by taking the campus units of measure (e.g. square footage of floor space) and dividing by the number of people assigned to a certain craft

c. Used as an indicator of workload by craft

d. Analyze by comparing to other APPA institutions of similar size

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